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(MISSIONS P-37/P-38)
PROJECT DEVELOPMENT PLAN *

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MARINER R PROJECT DEVELOPMENT PLAN

Approval of this Project Development Plan indicates acceptance of the responsibilities outlined herein, and commitment of the necessary resources of the Jet Propulsion Laboratory and the Marshall Space Flight Center to implement these responsibilities in the manner described in this Project Development Plan.

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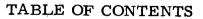
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SECTION I

PROJECT SUMMARY

A. OBJECTIVES

The purpose of the Mariner R (Agena) project is to perform the P-37/38 missions to Venus in 1962. The Mariner R is a replacement for the Mariner A project which was cancelled during September 1961.

The primary objective of the Mariner R project is to develop and launch two spacecraft to the near vicinity of the planet Venus in 1962, to receive communications from the spacecraft while in the vicinity of Venus, and to perform a scientific measurement of the planet. A secondary objective is to make interplanetary measurements on the way to Venus and in the vicinity of Venus.

The launch vehicle to be used in this project is the Atlas-Agena B, providing spacecraft weight of approximately 446 pounds.

It is planned to launch two probes sequentially off the same pad. All activities will be planned to exploit the limited launch period to the maximum extent.

The Mariner R spacecraft design will be retained as a backup for the 1964 Venus mission, if required.

B. TIME REQUIREMENTS

All planning is based on a nominal launch period of 56 days, from 18 July through 12 September, with a separation of 21 days between the two launchings off the same pad.

Nominal launch dates of 19 July and 9 August have been established.

The actual launch period will be determined with the resolution of certain weight and performance uncertainties which could result in the following:

Pessimistic Estimate:

44 days - 26 July through 8 September

Nominal Period:

56 days - 18 July through 12 September

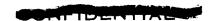
Optimistic Period:

67 days - 10 July through 15 September

A daily launch window of 1 hour is required, with 2 hours desired, in all systems. Flight times vary from about 139 days at the end of the period with a resulting encounter period of December 8 through December 17. The communication distance at encounter will vary from about 52 to 60 million kilometers. The miss distance at the planet will be such that there is a 99% probability of the space-craft approaching within 30,000 km \pm 15,000 km of the center of Venus with a probability of 1 in 1,000 of impacting on the planet.

Since the time from the first consideration of a Mariner R mission to its launch date is less than one year, many aspects of this project must take on the characteristics of a "crash" program.





C. COSTS

The estimated requirement for funds to accomplish the Mariner R project is as follows:

Required Funds (millions)

Fiscal Year	JPL	MSFC
1962	13.5	16.5
1963	3.5	

JPL costs include all costs, such as manpower, with the exception of DSIF costs.

DSIF costs in support of the Mariner R project cannot be segregated from other projects and are included in the DSIF operating costs.

Internal MSFC manpower costs are not included, in accordance with MSFC internal funding practices.

D. MANPOWER

The estimated requirement for manpower to accomplish the Mariner R project is as follows:

Total Manpower (man years)

Fiscal Year	JPL	MSFC
1962	485	6
1963	165	6

DSIF manpower in support of the Mariner R project cannot be segregated from other projects and is included in the DSIF manpower allocations.



SECTION II

JUSTIFICATION

By August 1961 it had become evident that the Centaur vehicle would not be available for the time of the 1962 Venus opportunity. A review of the Planetary Program resulted in a decision that the opportunity need not be missed and that a lighter spacecraft comprised of Mariner A and Ranger hardware was to be built to fly on Atlas-Agena B. The decision was based on the immediate availability of Mariner A and Ranger equipment and designs including a midcourse correction system which would place the spacecraft near the planet. Existing Ranger Project relationships with the Agena system were already established and would be utilized wherever possible.

The Mariner R project is not planned to continue after the 1962 launch except as a potential backup mission for the 1964 Venus mission if Centaur vehicle developments make this course advisable. The possibility of utilization of the 446 pound Mariner R spacecraft for a Venus mission in 1964 will be marginal however, due to higher energy requirements in 1964 than in 1962.

Mariner R activities in spacecraft technology and science will enhance the probability of successful missions in 1964.



SECTION III

HISTORY AND RELATED WORK

The Mariner R project is based on both Ranger and Mariner A technology.

The Ranger project is providing a few of the elements of hardware to be actually used in the Mariner R spacecraft. The cancelled Mariner A project is also providing equipment. The Agena B vehicles allocated to the Ranger project can be used in the Mariner R project, but require some modification in the method of reducing the weight of the Agena vehicle. It is planned that many of the Ranger procurement contracts, organizational relationships, range requirements, and launch-to-injection instrumentation facilities will be applied directly to the Mariner R.

Mission evaluation, trajectories, and postinjection instrumentation, commands, flight sequences, and scientific aspects are examples of Mariner A project technology that are directly applicable to the Mariner R project.

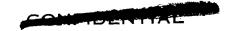
The Mariner spacecraft design was influenced by the experience and data obtained in past launchings. Pioneer IV was launched on 3 March 1959. The 13.4 lb spin-stabilized payload passed the moon at 37,000 miles distance and then proceeded into heliocentric orbit about the sun. Significant radiation data was obtained which extended and confirmed information on levels in the Van Allen radiation belts and in cislunar space. Engineering data as to the operation of equipment in space flight was also obtained. Pioneer V, which was launched 11 March 1960, placed a 94.8 lb spin-stabilized payload into a heliocentric orbit between the orbits of Earth and Venus. Communications were maintained until the probe was 22.5 million miles from Earth. Valuable experience was gained in the field of data transmission upon command on long range missions. Scientific information on the Earth's magnetic field as well as interplanetary magnetic fields was gathered. Ring currents about the Earth were also discovered. Other scientific achievements included a measurement of the interaction of solar winds and the Earth's magnetic field and a discovery that the so-called Forbush decrease in cosmic-ray intensity at the beginning of a solar flare is not confined to the region of the Earth.

Following these missions the Vega project was to perform missions to the moon and to Mars in 1960, and Venus in 1961. As a part of the Vega effort, JPL performed considerable design on attitude-stabilized spacecraft for these missions prior to the Vega project cancellation late in 1959.

The Vega project was followed by the Ranger project. The Ranger project is based upon utilization of the Atlas-Agena B launch vehicle. The Ranger project is basically divided into two major models: Ranger RA-1 and RA-2, which were to demonstrate the principles of attitude stabilized spacecraft of the fly-by design, both failed to be properly injected by the Agena, and the Ranger RA-3, and on, designed to perform an instrumented capsule landing on the moon.

Following the Ranger project, the Mariner A project was authorized to conduct the P-37/38 and follow-on fly-by missions to Venus. The Mariner A spacecraft design was an outgrowth of the Vega and Ranger designs and was based upon utilization of the Atlas-Centaur launch vehicle.

The Mariner A project was cancelled shortly after the launching of Ranger RA-1 when it became evident the Centaur would not be available for the 1962 missions. Therefore, much background had been developed for Mariner A from the Ranger project.





A direct forerunner of the Mariner R project as defined in this Project Development Plan is the Mariner A which was designed to perform fly-by missions to Venus at the same opportunity as the Mariner R. At the time of its cancellation, Mariner A design had been virtually completed, much of the hardware had been fabricated and to some extent tested, and the equipment was within 8 weeks of being delivered to the JPL Spacecraft Assembly Facility for assembly and system test.

SECTION IV

TECHNICAL PLAN

A. GENERAL

This section provides a general description of the Mariner R system as it exists in November 1961.

Primary sectional division B contains the Mariner R spacecraft description as it exists in November 1961.

Primary sectional division C describes the Mariner R spacecraft ground support equipment.

Primary sectional division D describes the Atlas-Agena Blaunch vehicle as used for the Mariner R missions.

Primary sectional division E describes the Deep Space Instrumentation Facility (DSIF).

Primary sectional division E describes the Space Flight Operations Facility (SFOF).



B. MARINER R SPACECRAFT

1. SPACECRAFT DESCRIPTION

The Mariner R spacecraft will contain the following elements:

A system for planetary and interplanetary scientific measurements. Solar power panels and power storage and conversion equipment. Two-way communications equipment. Environmental control equipment. Attitude control based on tracking of the sun and earth. Midcourse maneuver.

Instrumentation and data handling.
Modified Ranger structure.

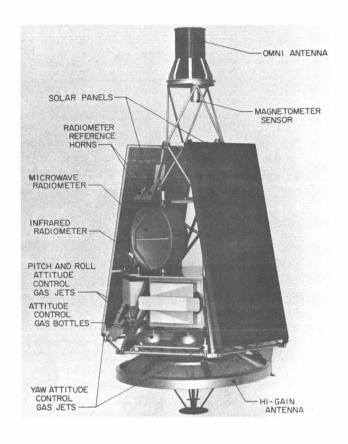
Physically, the spacecraft resembles Ranger RA-1 except that the superstructure supporting the omni-antenna will be modified. Functionally the Mariner R performs much like the Ranger RA-1 where standard events are controlled by a central clock and special events are controlled by real time commands, and it utilizes Mariner A developed hardware that is designed with the pecularities of plan-

etary missions in mind.

The gross configuration of the spacecraft is shown in Figure IV-1; a block diagram of the spacecraft is shown in Figure IV-2.

Separation from the Agena is performed as on the Ranger. Solar acquisition is immediately initiated. The Long Range Earth Seeker originally planned for the Mariner A is used for earth acquisition and is aligned to the directional high gain antenna. Pointing of the antenna consists of proper spacecraft roll and antenna hinge orientation while remaining locked onto the sun. Until earth acquisition communication with the spacecraft must rely on the omni-antenna.





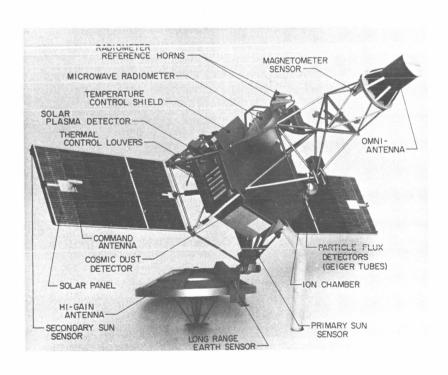
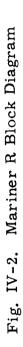
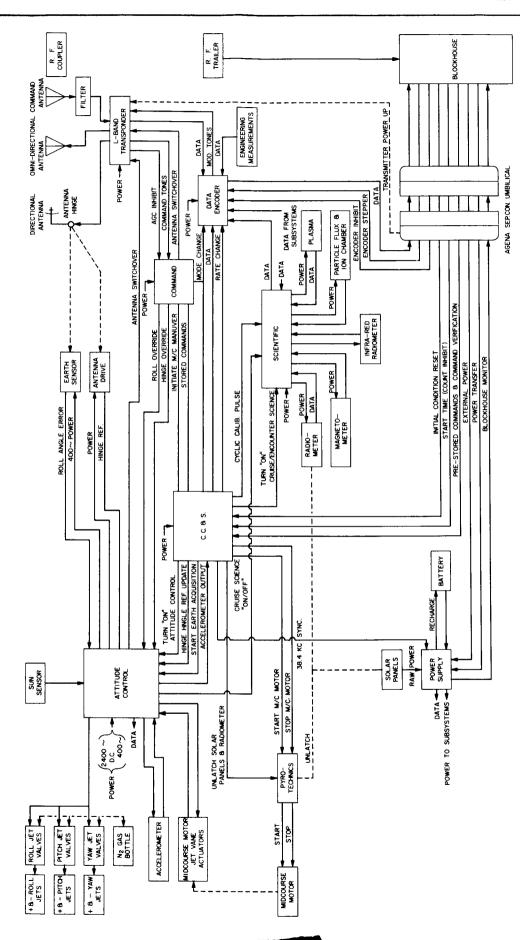


Fig. IV-1. Mariner R Configuration







IV-4



2. DESIGN CRITERIA

Design criteria applicable to the spacecraft for Mariner R missions are described in the following subparagraphs.

a. Competing Characteristics

- (1) Schedule which launches one, certified, operating spacecraft in the 1962 launch window.
- (2) Reliability of all elements of the system necessary to get to the vicinity of Venus and identify the fact the spacecraft is there.
- (3) Reliability of radiometric temperature measurement on planet and the transmission and reception of such data during encounter.
- (4) Schedule which launches the second, certified, operating spacecraft in the 1962 launch window.
- (5) Reliability of interplanetary measurements and the transmission and reception of such data during cruise.
- (6) Reliability of all subsystems associated with identifying a failure system necessary to accomplish (2), above.
- (7) Reasonable assurance of not impacting Venus (since the spacecraft is not to be sterilized).

b. Schedule Effects

It is required that a design and components which are compatible with the mission development time schedule be utilized.

c. Defined Characteristics

(1) Weight/Launch Period/Launch Window

Maximum injected spacecraft weight allowed: 446 pounds.

Launch Period: 47 days minimum required.

Launch Window: 1 hour minimum required - 2 hours desired.

(2) Effect on Agena Vehicle

Certain design constraints for this vehicle may put restrictions on the planetary design. The planetary mission requirements cannot require appreciable changes in the Agena vehicle with the exception that equipment may be removed from the Agena to permit a greater spacecraft weight. Reliability, cost and schedule assurance are all involved in this requirement. In this connection, the present Agena shroud design is taken as an unalterable limitation for this spacecraft design.

3. FUNCTIONAL DESCRIPTION

a. Antennas

The antenna system consists of an adaption of the Ranger RA-1 omni-directional antenna, a modified Mariner directional antenna, and a Mariner A command antenna system. The feed is to be changed from a linearly polarized feed to a circularly polarized feed to provide communication system





gain. The directional antenna is to be pointed towards the earth in the same manner as RA-1 and RA-3. One command antenna will be located on the back of one of the solar panels and another on the front as in the Mariner A.

b. L-band Transponder

For both telemetering and command, a single L-band subsystem is employed. The transmitter-receiver to be used is the L-band transponder designed for Mariner A. This system is a repackaged version of the RA-3 transponder, and is lighter, has a more efficient receiver and more efficiently uses the available transmission power. This unit will transmit three watts over the omni-antenna or the directional antenna and receive through the command antennas.

c. Data Encoder

The data encoder is a stripped-down version of the Mariner A data encoder. It employs the pseudo-noise technique developed for long-range, long-life telemetry with a capability of 16 bps at Venus distance. To increase the assurance of success the bit rate at Venus distance will be set at 8 bps. All engineering and scientific data is transmitted in real time.

d. Command Subsystem

A modified Mariner A pseudo-noise type command system is used. Eleven ground commands will be provided. Eight are of the real time variety with an actuating pulse being generated. The remaining three are for generation of the midcourse maneuver.

e. Attitude Control

The Mariner A attitude control system is used, with simplifying modifications. The attitude control subsystem will orient the solar panels towards the sun and point the directional antenna towards the earth. If the attitude is disturbed, the attitude control system will reacquire the sun and earth. The simplifying modifications consist of eliminating the short range earth sensor. This leaves the long range earth sensor to establish pointing of the high gain antenna. If the long range earth sensor is unmodified, earth acquisition will not be possible until about 5-8 days after liftoff. Goldstone should be able to receive the spacecraft omni-antenna transmission through the 5-8 day period.

f. Power

The power subsystem is based in modified Mariner A solar panels. As most of the subsystems to be used are modified Mariner A, the electronics of the power subsystem will be Mariner A, providing a 50-volt, 2400 cps square wave as the basic power source. The battery will be a Mariner type battery.

g. Central Computer and Sequencer

A simplified RA-3 CC&S will be used. A modified module will be added to provide cyclic functions and provide switching events up through Venus encounter.

h. Thermal Control

The thermal control of the vehicle will be accomplished by marrying the passive RA-3 thermal control to the semi-active Mariner A louvre technique.



The basic RA-3 hex is employed. A new omni-antenna support will be added as well as a new support for the long range earth sensor. Other items to be designed are sun sensor mounts, and science supports. Some packaging changes are required. The only articulating members are two solar panels, a one-degree of freedom high-gain antenna, and a scan for the radiometric measurement.

j. Midcourse Propulsion

The midcourse propulsion system for the Mariner R vehicle is essentially a Ranger RA-3 50-pound thrust monopropellant hydrazine unit. Modifications to the RA-3 design consist primarily of surface finish changes to tankage, etc., to accommodate the Mariner R thermal control requirements, the substitution of nitrogen for helium as the pressurizing medium to better accommodate the eight day launch-to-midcourse firing system storage requirement, and envelope changes so that the propulsion system can be loaded into the spacecraft through the bottom rather than the top of the hex as in Ranger. The unit will be capable of imparting a maximum velocity increment of 60 meters/sec to a 460-pound spacecraft, although weight restrictions limit fueling to a 45 meter/sec capability.

k. Space Science

(1) List of Experiments

Table IV lists the scientific equipment proposed for the Mariner R project and its intended usage.

Table IV - Mariner R Scientific Equipment										
Equipment	Planet-oriented experiment	Planet-vicinity experiment	Interplanetary experiment							
Radiometer	x	·								
Infrared detector	x									
Magnetometer		x	x							
Charged particle detectors		x	x							
Plasma detector			x							
Micrometeorite detector		x	x							

A data conditioning system is a new design requirement to match the scientific instrument outputs to the communication system. This function was performed in Mariner A by the Data Automation System, which also performed data storage; however, due to weight limitations, the DAS is not applicable to Mariner R.

A detailed description of the scientific experiments and equipment follows.





(2) Radiometer Experiment

The purpose of this experiment is to obtain information which will assist in the determination of the nature of the atmosphere of Venus and the role that it plays in the radiation balance of the planet. It is hoped to obtain information on the temperature of the surface and possibly its nature. The composition of the atmosphere and in particular the presence of water vapor below the cloud layer may be determined. The microwave brightness temperature is measured at two wavelengths and the phenomena investigated are selective absorption, limb brightening, and phase effect.

A single antenna will share the two wavelengths of 13.5 and 19.0 mm. The antenna will be mounted with its axis perpendicular to the roll axis of the spacecraft, and will be moved so as to scan a sector 60 degrees above and 60 degrees below a plane parallel to the ecliptic. This scan will begin 24 hours prior to planetary encounter at an angular rate of 1 degree per second. As the spacecraft moves by the planet at encounter a limb of the planet will first be intercepted by the plane of the antenna scan. At this time the scan rate will be reduced to 0.1 degree per second, and will continue until the antenna axis is 5 degrees off the planetary limb. The scan will then reverse its direction and another chord of the planetary disk scanned. Again when the 5 degree off the limb position is reached, reversal occurs and the operation repeated. Thus, an approximately sinusoidal path of one or more periods is scanned across the disk of the planet. If the planet is lost during any part of this scan, the scan rate and amplitude returns to the initial mode until the planet is again acquired, whereupon the lower scan rate takes over.

The receiver is of the crystal video type with an rms noise fluctuation of 5 degrees K on the 13.5 mm wavelength band, and 8 degrees K on the 19 mm band. The over-all accuracy is of the order of magnitude of \pm 1.0 percent at 600 degrees K. The integration time of the instrument is 20 seconds, and the antenna beam width cannot exceed 2.4 degrees.

(3) Infrared Experiment

This experiment, in conjunction with the radiometer experiment, will result in a fairly complete radiation picture of the planet. The existence of fine structure of the cloud layer may be determined, which if of sufficient dimensions, will allow observations to be made through to lower levels, or possibly even the surface. The selection of wavelengths will be such as to give information on atmospheric composition.

The instrument will be rigidly attached to the radiometer package with the optical axis of the infrared instrument parallel to that of the radiometer antenna. Through the use of interference filters, two wavelength regions will be utilized, 8 to 9 microns, and 10 to 10.5 microns. The optical system has a speed of f/2.6 and a focal length of 7.8 cm, with a total angular field of view of 1 degree. A thermistor bolometer is used as a detector with a sensitivity of about 2 degrees K for the noise equivalent temperature.

(4) Magnetometer Experiment

This experiment will enable a determination to be made of the three mutually perpendicular components of the magnetic field in the interplanetary space between the Earth and Venus, and in the vicinity of Venus at planetary encounter. If the planet has a magnetic field of the same order of magnitude as that of the earth, its existence will definitely be determined. However, if the Venusian magnetic field is extremely small, whether or not it is detected will be a function of the encounter distance. For this reason, a trajectory which will allow the closest approach is desired.



The instrument is of the fluxgate type with the sensor depermed and degaussed from the magnetic effects of the spacecraft. It will make measurements over two ranges: 0 to \pm 64 gamma, and 0 to \pm 640 gamma. Sensitivity is such that changes in any of the three magnetic field components of the order of magnitude of 0.5 gamma can be detected.

(5) Charged Particle Experiment

This experiment consists of an ionization chamber and several Geiger-Mueller counters. Both instruments detect the presence of electrically-charged particles by the ionization they produce in a gas surrounding a charged collector. Information as to the temporal and spatial distribution of these particles, as well as their variations and energies is of great importance in the understanding of the nature of cosmic radiation and of the trapped particle regions which are known to surround the earth, and which are suspected to exist at the planets.

An ionization chamber of the Neher type will be utilized to detect the presence of protons above 10 Mev energies, and of electrons above about 0.4 Mev. Its dynamic range is considerable; from several instrument counts per hour to several per second.

Two Geiger-Mueller counters, type RCL 10311 will be utilized to count alpha particles above 40 Mev in energy, protons above 10 Mev, and electrons above about 1 Mev. One of these counters will be shielded with a gold-plated, steel envelope, and the other with a beryllium envelope. This allows a discrimination between protons and electrons. Their counting rate lies between about 20 per second for the cosmic ray background, and 10,000 per second.

One Anton type 213 will be utilized to cover a lower particle energy range, and will count protons above 0.5 Mev in energy, and electrons above 35 Kev. Here, the counting rate lies between 0.2 counts per second for the cosmic ray background and 20,000 per second.

(6) Plasma Experiment

This experiment is designed to obtain information on the extent, variations in, and mechanism of the solar corona. To fully exploit this experiment, the results must be carefully correlated with those from the magnetometer experiment, and with solar phenomena observed here on Earth. This information is of extreme importance in our understanding of the dynamics of stellar bodies, and of the regions about them.

A curved plate particle spectrometer of the JPL design will be utilized to detect the energy flux of solar protons. It has a 10 degree angular aperature and will be located on the spacecraft so as to look in a direction parallel to the roll axis. Since the spacecraft will be oriented so that this axis is always pointing toward the sun, this assures that the spectrometer will be oriented at all times in this direction. The instrument will measure the flux at 10 energy levels, from 250 ev to 8400 ev. The current ranges which are measured are from 10^{-6} to 10^{-13} amperes.

(7) Micrometeorite Experiment

The purpose of this experiment is to measure the temporal density of cosmic dust particles which exist in interplanetary space and in the region about the planets. Information gained from this experiment will be useful in formulating the history and dynamics of evolution of the solar system.

A momentum type experiment is planned, utilizing a crystal microphone fastened to an impact plate, which is fixed with respect to the spacecraft. The plate is positioned such that its plane is roughly perpendicular to the direction of motion of the earth in its orbit. Two levels of particle mass detection are utilized, with lower limits of 10^{-7} and 10^{-8} g. All particles above this mass limit, with





components of momentum perpendicular to the plate greater than 10⁻⁴ dyna-sec will be detected. The microphone circuitry will allow a counting rate of 50 per second, but since this is far above the expected rate, the two counting levels are each connected to a 2 stage binary counter. Each counter is reset approximately every 36 seconds.

(8) Operating Periods

All instruments except the radiometer and infra-red detector will be operated during the entire flight. The radiometer and infra-red experiments will operate during the encounter part of the flight. The data will be transmitted in real time.

4. MARINER R SPACECRAFT WEIGHT STATUS

The current weight allocations for spacecraft subsystems are shown in Table IV-2.

Table IV-2. Spacecraft Weight Allocations

Subsystem	Weight Allocation (pounds)
Transponder	20.20
Antenna	19.81
Command	9.50
Power	99.89
Central Computer and	
Sequencer	10.95
Data Encoder	15.29
Attitude Control	55.81
Structure	83.00
Actuators	3.40
Pyrotechnics	3.75
Motion Sensors	1.33
Spacecraft Wiring	33.00
Propulsion	32. 08
Thermal Control	14.30
Space Science	42.10
Contingency	1.59
TOTAL	446.00



5. FLIGHT SEQUENCE

- a. The flight sequence describes the basic functions of the mission, and no attempt is made to present the detail required for actual design. However, the general outline and command structure is complete.
- b. The sequence results from a blending of Ranger and Mariner capabilities with the addition of certain new features to increase mission reliability and capability. The new items, repeated here for clarity, are:
 - (1) A timing sequence contained in the CC&S will start the Venus encounter experiments.

 A ground command will be available as a backup to initiate the sequence if the CC&S timing sequence does not occur.
 - (2) As the spacecraft nears Venus a simple scan will allow the planet oriented experiment to acquire the appropriate data.
 - c. The flight sequence is shown in the following Table IV-3.

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Table IV-3. Flight Sequence of Events

Mode		Event	Time	Source	Destination	Comments
ou 7- cy	,	Lift off	Т			
nns il ctio	8	Spacecraft injection	T + 21 to 35 min			
L to	<u>ო</u>	Spacecraft separation	Event 2 + 2.6 min			
		a. Transmitter power up		Separation Connector	L-band	
		b. Arm pyrotechnics				
		c. Enable CC&S		Separation Connector	CC&S	
	4.	a. Unfold solar panels	T + 44 min	CC&S	Pyro	Fixed time
		b. Unlatch radiometer				
	က်	Switch to 33 bps data rate RTC-9		Command	Encoder	As necessary
—uo	. 6	Turn on attitude control	T + 60 min	CC&S	Attitude Control	Fixed time
ttia		a. Extends antenna				
rcqu1		b. Activates sun sensor system				
<i>7</i> —		c. Activates gas jet system				
		d. Commences automatic sun acquisition				
	7.	Sun acquisition complete	T + 60 to 90 min			
		a. Turn off gyros				
	œ <u>.</u>	Remove inhibit on automatic earth acquisition	T + 167 hrs	CC&S	Attitude Control	
		a. Starts roll searchb. Turns on gyrosc. Decrease data rate		CC&S	Encoder	

Mode Event Time Source Destination Comments CW hinge override command RTC1 CW hinge override command RTC2 CW hinge override command RTC3 CW hinge override command RTC3 CW hinge override command RTC3 10. Barth acquisition complete Event 8 + 0 to 30 a. Roll search stops d. Turn on cruise science e. Swttch L-band from omni- 11. Swttch L-band to omni- swttch L-band to omni- trajectory correction commands a. Roll turn polarity and duration SC1 c. Velocity increment SC3 c. Velocity increment SC3 antenna RTC4 Command L-band L-band L-band As necessary throughout As necessary throughout As necessary throughout As necessary throughout As necessary antenna RTC4 Command Command Coccur anythine attent turn polarity and duration SC1 c. Velocity increment SC3 c. Velocity																***************************************
Flight Sequence of Events (Contid)		Comments	As necessary throughout flight								As necessary throughout	ilignt	Nominal time given, can occur anytime	over Gold- stone	***************************************	
Event CW hinge override command FRTC2 CCW hinge override command RTC3 CCW hinge override command RTC3 10. Earth acquisition comple a. Roll search stops b. Hinge servo starts c. Gyros stop d. Turn on cruise scler e. Switch L-band from to directional antenna RTC4 Switch L-band to direction aritema RTC4 Switch L-band to direction commands a. Roll turn polarity and duration SC1 b. Pitch turn polarity a duration SC2 c. Velocity increment S. 13. Switch L-band to omnialized antenna RTC4 c. Velocity increment S.		Destination	A/C						Science	L-band	L-band		CC&S			L-band
Event CW hinge override command FRTC2 CCW hinge override command RTC3 CCW hinge override command RTC3 10. Earth acquisition comple a. Roll search stops b. Hinge servo starts c. Gyros stop d. Turn on cruise scler e. Switch L-band from to directional antenna RTC4 Switch L-band to direction aritema RTC4 Switch L-band to direction commands a. Roll turn polarity and duration SC1 b. Pitch turn polarity a duration SC2 c. Velocity increment S. 13. Switch L-band to omnialized antenna RTC4 c. Velocity increment S.	its (Cont'd)	Source	Command			-	-		A/C	A/C	Command		Command			Command
Event CW hinge override command FRTC2 CCW hinge override command RTC3 CCW hinge override command RTC3 10. Earth acquisition comple a. Roll search stops b. Hinge servo starts c. Gyros stop d. Turn on cruise scler e. Switch L-band from to directional antenna RTC4 Switch L-band to direction aritema RTC4 Switch L-band to direction commands a. Roll turn polarity and duration SC1 b. Pitch turn polarity a duration SC2 c. Velocity increment S. 13. Switch L-band to omnialized antenna RTC4 c. Velocity increment S.	t Sequence of Ever	Time			Event 8 + 0 to 30 min								T + 8 days			
Zegrach ————————————————————————————————————	Flight	Event		CCW hinge override command RTC3					Turn on cruise	·		Switch L-band to directional antenna RTC5	•			
Mode			<u>ග</u>					aım	72/7		-	· · · · ·				
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	Comments	Nominal time given. Can occur anytime over Goldstone after event 10 and 12																
	Destination	Saco		A/C	Science	A/C	A/C					۵/۵) 	A/C				
	Source	Command	,	CC&S	A/C	CC&S	CC&S			······		Č	2 2 2 2	Saco				
Sequence of Events (Cont'd)	Time	T+8.1 days	Event 14 + 0 min				Event 14 + 60 min						Event 16 + 0 to 8.7 min	Event 14+72 min CC&S				
Flight Sequence		Initiate midcourse maneuver RTC6	Start propulsion sequence	a. Turn on accelerometer	b. Turn off cruise science	c. Turn on gyro	a. Turn off earth sensor power	Inhibit earth acquisition	b. Connect roll gyro capacitor	c. Set roll turn polarity	d. Exit antenna	e. Start roll turn	Stop roll turn	. a. Turn on autopilot	b. Switch out sun sensor pitch and yaw error signals	t pitch pacitor	d. Set pitch turn polarity	e. Start pitch turn
		14.	15.				16.						17.	18.				
	de			- ,		ı.	Anəu	Ms	e s in	oot	Mī							
	Mode																	

			Flight Sequence	Flight Sequence of Events (Cont'd)			
Mode			Event	Time	Source	Destination	Comments
	19.		Stop pitch turn	Event 18+0 to 16.7 min	CC&S	A/C	
	20.	เลื่	Start accelerometer integration	Event 14 + 94 min	CC&S	A/C	
		م	Command motor ignition		CC&S	Pyro	
	21.		Command motor shutoff	Event 20 + 0 to 2.5 min	CC&S	Pyro	
	22.	ส่	Turn off autopilot	Event 14 + 98 min CC&S	CC&S	A/C	
		þ	Switch out gyro capacitors				
enve:		ပံ	Command antenna to reacquisition position				
nsM 9s		ਰ	Relinquish CC&S control of gyro power and accelerometer				
gconı	· 	ď	Commence automatic sun acquisition				
oiM –	······································	f.	Switch in sun sensor error signals				
	23	Sun	Sun acquisition complete	Event 22 + 0 to 30 min			
		ង	Turn off gyros				
	24.		Remove inhibit on earth acquisition	Event 14 + 200 min	CC&S	A/C	
	· · · · · · · · · · · · · · · · · · ·	ದ	Turn on earth sensor power				
	<u> </u>	þ.	Turn on gyros				
		ပံ	Initiate roll search				
-							



	Comments		4 P. C.			- 71											
	Destination		L-band	Science			Science	Data Encoder		Science	Data Encoder			Science	Data Encoder		
1)	Source		A/C	A/C			CC&S	CC&S		Command	Command		rs	CC&S	CC&S		
Flight Sequence of Events (Cont'd)	Time	Event 24 + 0 to 3 min				Event 28 -10 hrs							Event 28+56,7 hrs				
Flight Sequence	Event	Earth acquisition complete		b. Turn off gyros c. Turn on cruise science	CRUISE	Begin encounter sequence	a. Turn on encounter science	b. Switch to encounter T/M mode	Start encounter operation backup RTC7	a. Turn on encounter science	b. Switch to encounter T/M mode	Nearest approach to Venus		a. Switch to cruise science			
		25.				26.			27.			28.	29.			 	
	Mode	er	idcour	W							J	(ə ş t	mo	oug	I		->

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	Comments		Backup Function	Occurs Throughout	9	 			
	Destination	Science Data Encoder		A/C Science	Power				
(p,	Source	Command		CC&S	CC&S				
Flight Sequence of Events (Cont'd)	Time			Every 16. 7 hrs Every 16. 7 hrs	•				
Flight Sequence	Event	30. Return to cruise operation backup RTC8a. Switch to cruise scienceb. Switch to cruise T/M mode	Reduce Data Rate	Hinge reference angle update	38.4 KC sync				
	Mode	ncounter	ख	yelic	m _∃				

6. ANALYSIS - TRAJECTORIES AND GUIDANCE ACCURACY

a. Introduction

The preliminary analysis of flying a Mariner Rspacecraft to Venus in 1962 has been completed. From the results presented, it can be determined how much geocentric energy is required for various cytherean firing periods and observe the trajectory characteristics associated with launch date. Preliminary results concerning the midcourse maneuver are also presented.

b. Firing Period and Firing Window

Fig. IV-3 shows a plot of difference in injected weight and C_3 , twice the total geocentric energy per unit mass or the vis viva integral, vs. launch date to Venus in 1962. The minimum energy trajectory to Venus in 1962 has a C_3 of .087 x 10 m/sec . To utilize a firing period greater than one day, this required C_3 must increase, and thus payload capability decrease. Note that for a C_3 of 0.115 x 10 m/sec , the permissible firing period is from July 24 to September 9, 1962. Trajectory characteristics have been determined for a launch period of 67 days, corresponding to a C_3 of 0.140 x 10 m/sec .

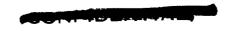
On any given launch day, the capability must exist to launch over a period of time. This period of time may be 60 min., 120 min., etc. Unless compensated for, a delay in the launch time will cause an error at Venus encounter. This error increases as the delay becomes longer. The method to be used for compensation of the delay involves simultaneous altering of the launch azimuth and the parking orbit time between Agena burning periods. Southeast launchings are preferred on any given launch day in order to obtain maximum tracking from the Deep Space Instrumentation Facility (DSIF). At present, a launch azimuth span of 96° - 108° east of north is used for the Ranger 3 mission. For this span of launch azimuths, a firing window of 60 to 90 minutes will exist for the proposed Venus launchings. Subject to range safety, this launch azimuth span might be increased to vary from 90° to 114°. If this greater span of launch azimuths is used, a firing window of 150 to 200 minutes will exist. Operational requirements associated with the launching of the spacecraft require a minimum 60 min. firing window. It is very desirable, however, that a 120 minute firing window be available on each permissible launch day.

c. Trajectory Characteristics

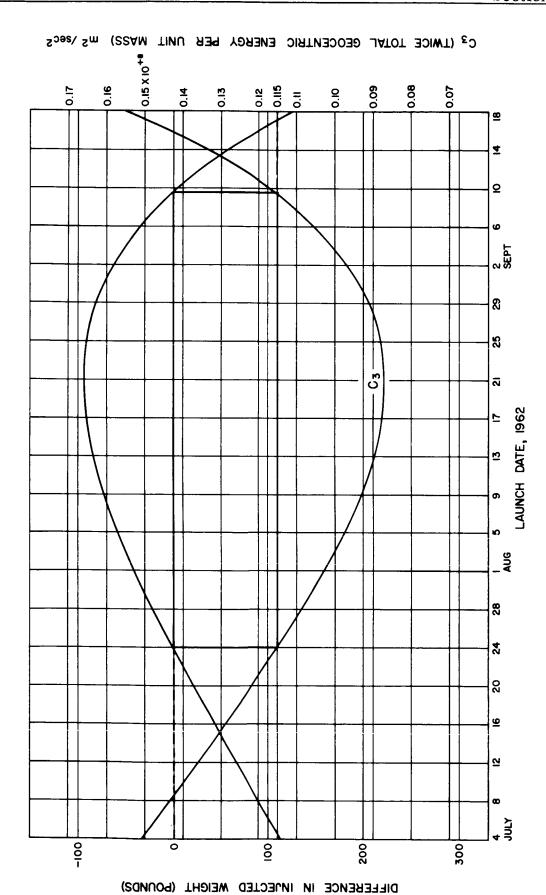
(1) Near Earth

For the Mariner R trajectories, the time of launch and the time from launch to geocentric injection will vary with launch azimuth and launch date. For a launch azimuth of 90° East of North, the longest time from launch to injection is approximately 35 minutes, taking into account all possible launch days. For a launch azimuth of 114° East of North, the shortest time from launch to injection is approximately 21 minutes. Figures IV-4 and IV-5 show the uprange and downrange extremes in injection locations for all Mariner R trajectories. The following launch times are associated with the corresponding launch date and launch azimuths respectively, for a 67-day firing period.

	For Launch Date of 10 July.	
Launch Azimuth	90° East of North, Launch Time	3:40 A.M., EST
Launch Azimuth	114° East of North, Launch Time	6:26 A.M., EST
	For Launch Date of 15 September	
	90 East of North, Launch Time	
Launch Azimuth	114° East of North, Launch Time	12:35 A.M., EST

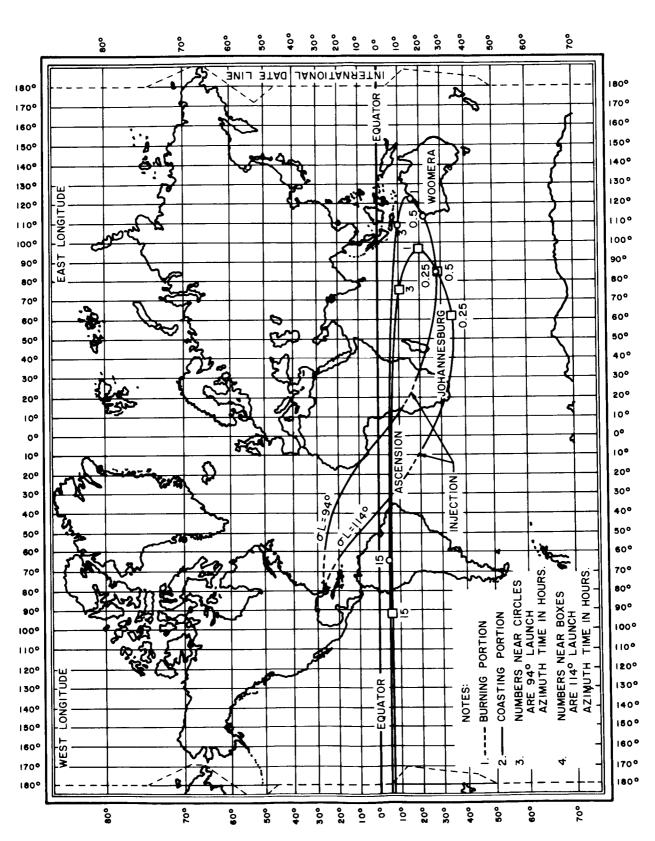






Difference in Injected Weight and C_3 vs. Launch Date to Venus Fig. IV-3.





ig. IV-4. Earth Track

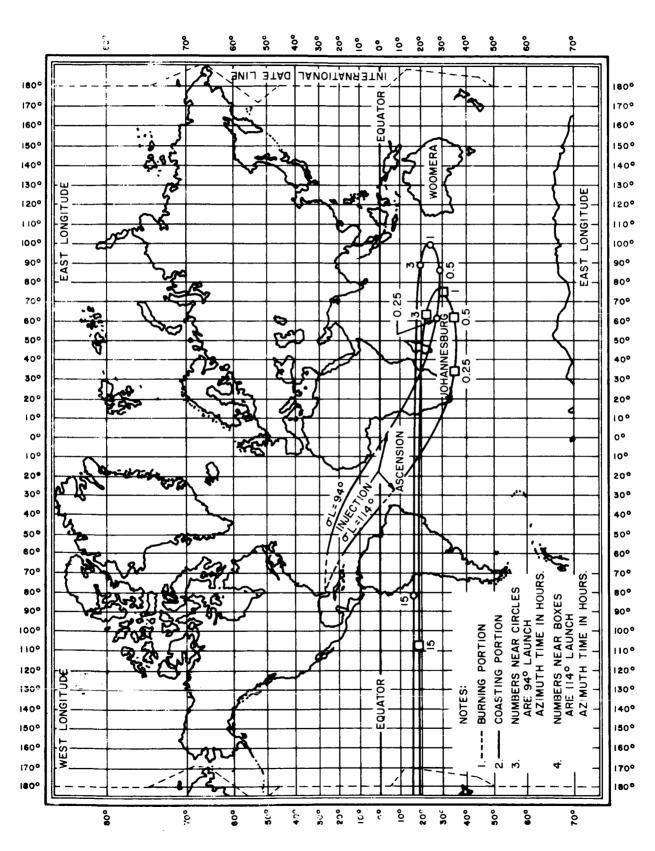
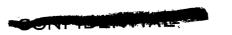


Fig. IV-5. Earth Track





Typical \circ dispersion values at injection are 8.7 m/sec velocity and 1.4 milliradians in angle of the velocity vector. Table IV-4 gives various trajectory characteristics over the selected firing period. The Earth-probe distance (from center of Earth) at three hours after launch is approximately equal to 73.5 thousand kilometers, but at eight days out the value will range from 2.1 to 2.7 million kilometers depending on launch date.

(2) Heliocentric Flight

Approximately 8 to 10 days after launch, heliocentric injection will occur. At this time the probe will commence to move primarily under the influence of the Sun in a near-elliptical orbit with the Sun at the focus. For the first 38 launch days of the firing period, the probe enters into its near-elliptical orbit before aphelion. For the remainder of the firing period, heliocentric injection occurs after aphelion. These heliocentric injection characteristics are implied by the values of the Earth-Probe-Sun angle given in Table IV-4. The approximate Earth-Probe-Sun-Angle is given for 8 days after launch. If the angle is less than 90°, the probe is outside the Earth's orbit and a heliocentric injection time before aphelion is implied. If the angle is greater than 90°, the probe is within the Earth's orbit and a heliocentric injection time after aphelion is implied. The maximum Earth-Probe-Sun-Angle occurs some 25-35 days before Venus encounter. This maximum E-P-S-A value probably will not exceed 170°. The Earth-Probe distance at this time will vary from 16 to 28 million kilometers depending on launch date. Flight time from launch to Venus encounter will vary from 150 to 93 days as the launch date is delayed from the earliest to the latest feasible launch respectively. The Earth-Venus communication distance at arrival will also vary with launch date, as several arrival dates will be utilized.

(3) Near Venus

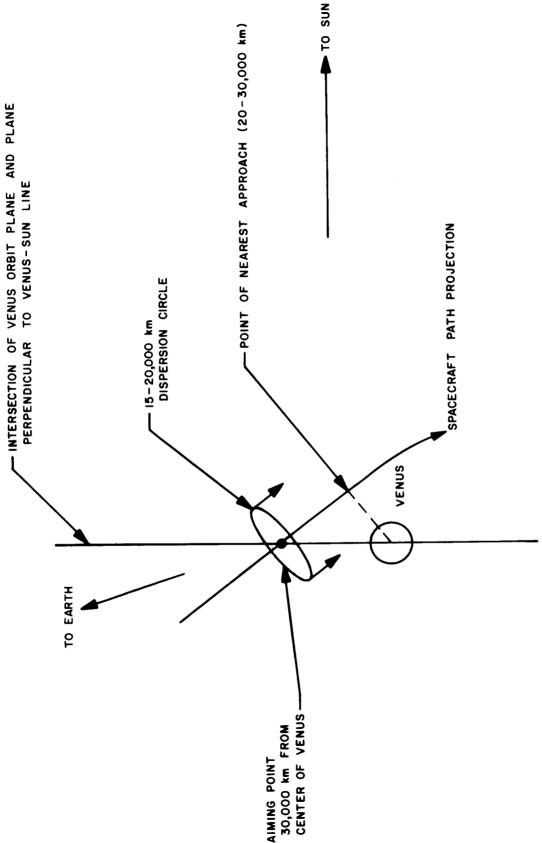
The near Venus trajectory is approximately a hyperbola with respect to the target planet. The hyperbolic excess velocity varies from 5.5 km/sec to 6.0 km/sec depending on launch date. The probe approaches Venus from above the ecliptic plane and from behind (i.e., catching up with Venus in its orbit around the Sun).

It is desired that the trajectory pass through a point which lies on the line of intersection of Venus' orbital plane and a plane normal to the Venus-Sun line containing the center of Venus. To reduce the probability of impact to less than 1 in 1,000, the point is approximately 30,000 km from the center of Venus. This nominal aiming point corresponds to a range of closest approach distances of 20,000 to 30,000 km dependent on launch date. Because of midcourse guidance errors, actual trajectories may miss the nominal aiming point by 15,000 to 20,000 km (3 σ). See Figure IV-6.

· · · · · · · · · · · · · · · · · · ·							—-т	г		- 1	т	
Earth-Venus Distance at Encounter (million of km)	50.6	50.6	52.3	52.3	54.0	54.0	55.8	55.8	57.7	57.7	59.6	59.6
Approximate Flight time (days)	150	143	144	135	136	127	128	119	120	106	107	93
Approximate* E-P-S at Venus Encounter (deg)	133.3	133.3	130.8	130.8	128.3	128.3	125.7	125.7	123.2	123.2	120.8	120.8
Maximum * E-P-S During Flight to Venus (deg)	170	170	170	170	170	170	170	170	170	170	170	170
Approximate* E-P-S at 8 days after launch (deg)	52	54	26	61	63	73	75	85	98	108	110	133
Approximate* E-P-S at 3 hours after launch (deg)	62	64	99	69	7.1	81	83	92	93	116	118	139
* c3 x10 m /sec	. 140	. 127	. 126	. 110	. 109	960.	. 095	. 088	780.	. 094	. 095	. 140
Launch	0	7	8	17	18	27	28	37	38	52	53	29

E-P-S is the angle between the Earth-Probe radius vector and the Sun-Probe vector. c_3 is twice the total geocentric energy per unit mass or the vis viva integral.

Table IV-4. Trajectory Characteristics, Mariner R From 10 July through 15 September 1962



PLANE OF PAPER IS PLANE OF VENUS ORBIT

Fig. IV-6. Near-Venus Geometry

C. SPACECRAFT GROUND SUPPORT EQUIPMENT

Spacecraft ground support equipment will consist primarily of three types of equipment: systems test complex, launch complex equipment, and launch checkout station. These equipments are described briefly below.

1. Systems Test Complex

The Systems Test Complex (STC) will be the basic test equipment unit used at JPL in tests and operations to verify the adequacy of the spacecraft design, fabrication, assembly, and flight readiness. The STC will have the capability to power, command, and monitor the performance of the spacecraft down to the assembly level.

2. Launch Complex Equipment

Launch Complex Equipment (LCE) will be used to power, command, and monitor the spacecraft during all pad operations. Detailed performance monitoring of the spacecraft during pad operation will be performed through the telemetry system. Hence, only gross performance parameters will be monitored by the LCE. The Mariner RLCE will be compatible with all hardware in the blockhouse, transfer room, and other fixed hardware at AMR Complex-12 as it is expected to exist at the completion of Ranger RA-4 activities.

3. Launch Checkout Station

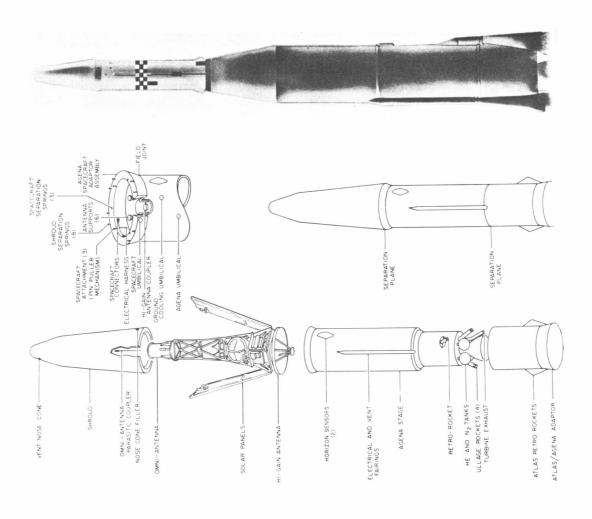
The L-Band Launch Checkout Trailer and Telemetry Trailer utilized in the Ranger RA-4 operation to establish RF communication and telemetry contact with spacecraft will be modified to a minimum extent and utilized in the Mariner R project. These two trailers combined constitute the Launch Checkout Station (LCOS).

D. ATLAS-AGENA B LAUNCH VEHICLE (Figure IV-7)

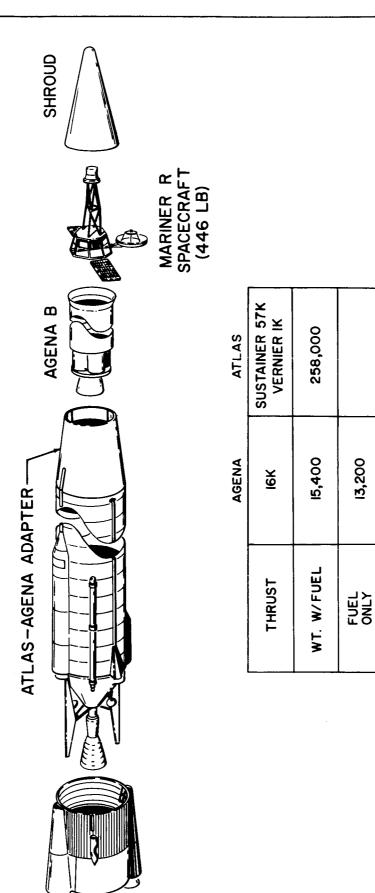
A brief description and breakdown of the configuration selected for the basic NASA Agena B stage is as follows. The stage differs from that used for Ranger RA-1 and RA-2 in that some 110 lbs have been removed to provide required spacecraft weight and launch period. The power supply and telemetry systems are significantly changed to reduce weight with the adapter sterilization diaphragm removal providing the largest weight reduction of some 63 lbs. Figure IV-8 is an illustration of the various components of the Atlas-Agena B-Spacecraft combination and depicts the inflight separation of the components. Dimensions of the vehicle are shown in Figure IV-9.

Figures IV-10 and IV-11 illustrate the Agena propulsion subsystem; Figure IV-12 shows principal components of the guidance and control subsystem.

The Atlas used with the NASA Agena B is an SM-65D series vehicle modified by the incorporation of the guidance discrete signals required by the Agena and by the provision of increased skin thickness in the upper conical portion of the oxygen tank.



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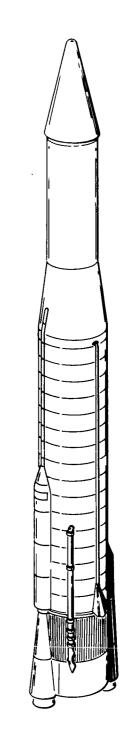


Fig. IV-8. Atlas-Agena B- Mariner R In-Flight Separation

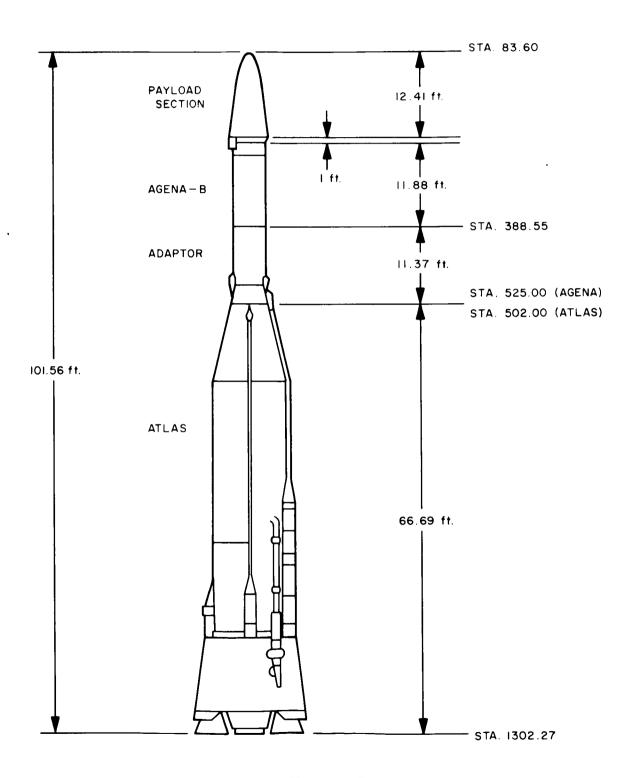
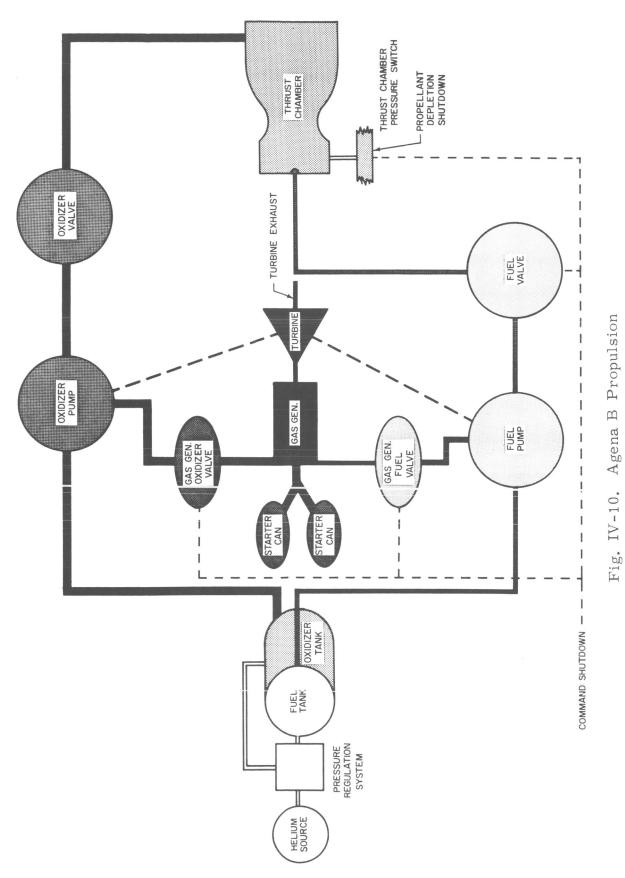


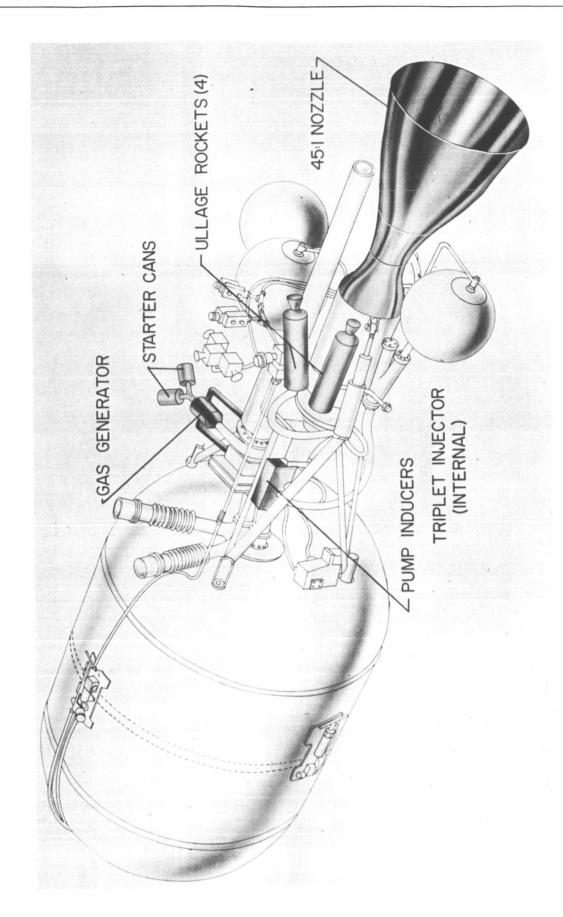
Fig. IV-9. Vehicle Dimensions





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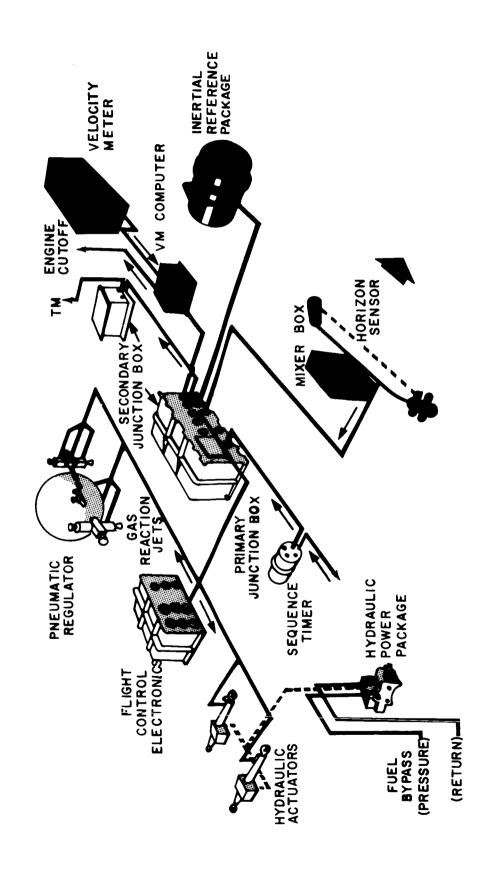


Fig. IV-12. Agena B Guidance and Control System





The functional sequence of events for the launch vehicle is as follows (reference Figures IV-13 and IV-14):

- 1. Atlas flight phase. After completion of prelaunch preparations and final countdown, the Atlas booster, sustainer, and vernier engines are ignited seconds before liftoff and the umbilical connections are severed as the vehicle rises from the pad. After flight has been attained, the vehicle will follow a programmed trajectory and later, after staging, programming will be assisted by radio-guidance commands. At a predetermined staging point the booster engines are shut down and discarded. The sustainer engine will continue to operate until the desired altitude, attitude, and velocity have been attained after which it is stopped. Vernier engine operation will be discontinued seconds after sustainer cutoff. Should a malfunction occur before separation from the Atlas the flight will be destroyed by means of a destruct command, transmitted from the ground to the Atlas and relayed to the Agena B. A charge in the adapter of the Agena B ruptures the propellant tanks, thereby destroying the vehicle by explosion.
- 2. Agena B Separation. Separation of the Agena B spacecraft combination from the Atlas immediately follows Atlas vernier cutoff and ejection of the nose fairing, or shroud. Momentarily before the cutoff of the Atlas sustainer engine, a guidance command from the Atlas will start the auxiliary timer in the Agena B to initiate the second-burn sequence at the termination of the parking orbit. Similarly, a guidance command will turn on the ascent timer in the Agena B. Simultaneously, the pneumatic flight control system in the Agena B will be pressurized; the destruct system will be disarmed; and the vernier engines will be cut off. Gyros in the Agena B will be uncaged. Separation is initiated by a guidance command signaling the ignition of the pin pullers and retrorockets in the booster adapter to retard flight of the booster adapter and the Atlas, permitting the Agena B spacecraft combination to draw free.
- 3. Coast. The coast phase is the period from the completion of separation to the preparation of the Agena B for operation. When separation is achieved, the pneumatic attitude control system is activated which, by means of gas jets, will cause the Agena B to pitch over, through an angle of approximately 14.4 degrees at an approximate rate of minus 60 degrees per minute. Pitch rate will be changed to approximately minus 2.4 degrees per minute when the pitchover maneuver is complete. The horizon sensor fairings will be ejected. Pitch and roll signals from the sensors will be transmitted to the pitch and roll flight control electronics channels, respectively. A pitch rate of minus 2.4 degrees per minute, in combination with the response of the flight-control electronics to the signals from the horizon sensors will cause the Agena B to remain in a relatively horizontal attitude with respect to the Earth. The Agena B spacecraft combination will continue coasting upward without rocket power.
- 4. First-Burn. At the conclusion of the coast phase two ullage rockets will be ignited to provide an impulse sufficient to place the propellants at the propellant pump inlets which insures engine ignition. Simultaneously, the velocity meter is armed for the purpose of integrating the velocity gained by the Agena B during the first-burn period, and determining the engine cutoff point. The pneumatic pitch and yaw attitude controls are activated to position the thrust angle of the engine during operation. The engine is ignited to provide the impulse needed to place the Agena B spacecraft combination into a parking orbit. The integrator causes engine cutoff when the required velocity is reached.
- 5. Parking Orbit. The parking orbit is nearly circular and at an altitude of about 100 nautical miles, the ascent timer is turned off while in orbit. Rate of pitch is changed to near minus five degrees per minute.
- 6. Second-Burn. In preparation for the second-burn time of operation, the sequence timer is turned on; the remaining ullage rockets are fired to place the propellants properly for engine ignition;

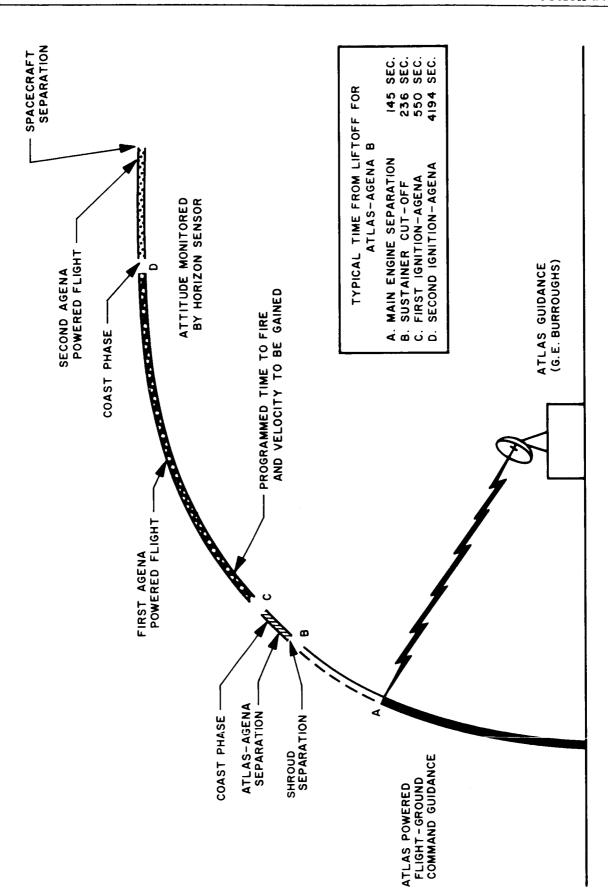


Fig. IV-13. Typical Flight Sequence Atlas-Agena B

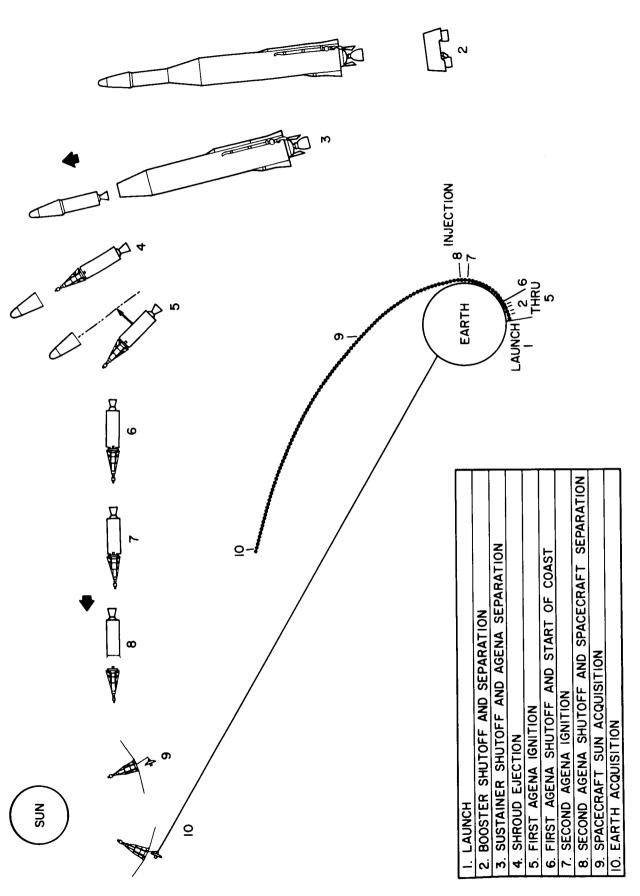


Fig. IV-14. Mariner R Launch-To-Injection Sequence

IV-34



the velocity meter is armed for integration, and the engine ignites. When the required velocity is gained the engine thrust is terminated.

- 7. Spacecraft Separation. The pin pullers securing the spacecraft to the payload adapter are ignited at the conclusion of the second-burn and the spacecraft is separated from the Agena B.
 - 8. Agena B Reorientation. Following spacecraft separation, the Agena yaws.
- 9. Retroaction. Venting of residual gases is then accomplished to prevent the unsterilized Agena from striking Venus and to allow the spacecraft to reach a specified minimum distance from the Agena within a given period of time.

E. DEEP SPACE INSTRUMENTATION FACILITY (DSIF)

The Deep Space Instrumentation Facility will be used for Mariner R to provide post-injection tracking of the spacecraft, command, and telemetry.

The DSIF presently consists of three deep-space stations (Figure IV-15), one mobile station (Figure IV-16), and the intersite communication links which provide for the transfer of data and for operations administration. The deep-space stations are presently equipped with 85-ft diameter reflectors and can track at angular rates to approximately 1 deg/sec. The mobile station is equipped with a 10-ft diameter reflector and can track at angular rates to 10 deg/sec. The mobile station is used primarily for early acquisition and for command, telemetering, and tracking from injection to about 10,000 miles.

The DSIF provides a precision radio-tracking capability which measures two angles, radial velocity and range. In addition, the DSIF provides for the transmission of spacecraft commands and for the reception of raw spacecraft telemetry signals. The DSIF is continuously undergoing long-term improvement and modernization consistent with the state of the art and space programs requirements.

JPL is under contract to NASA for the research, development, and fabrication of the deep-space and mobile stations and for the technical coordination and liaison necessary to establish and operate the DSIF throughout the world. Overseas deep-space stations at Woomera, Australia, and Johannesburg, South Africa, will be operated by personnel provided by cooperating agencies in the respective countries. The Goldstone, California, station and the mobile stations will be operated by U. S. personnel. The three deep-space stations are spaced at approximately equal intervals of longitude around the Earth in order to provide continuous view of spacecraft above 10,000 miles altitude.

The mobile stations will, in most cases, be located so as to cover the injection point and immediate post-injection trajectory of the spacecraft.

A NASA-operated communication netlinking the stations is utilized for data transfer and for operational control of the DSIF.



EPD-50 Section IV

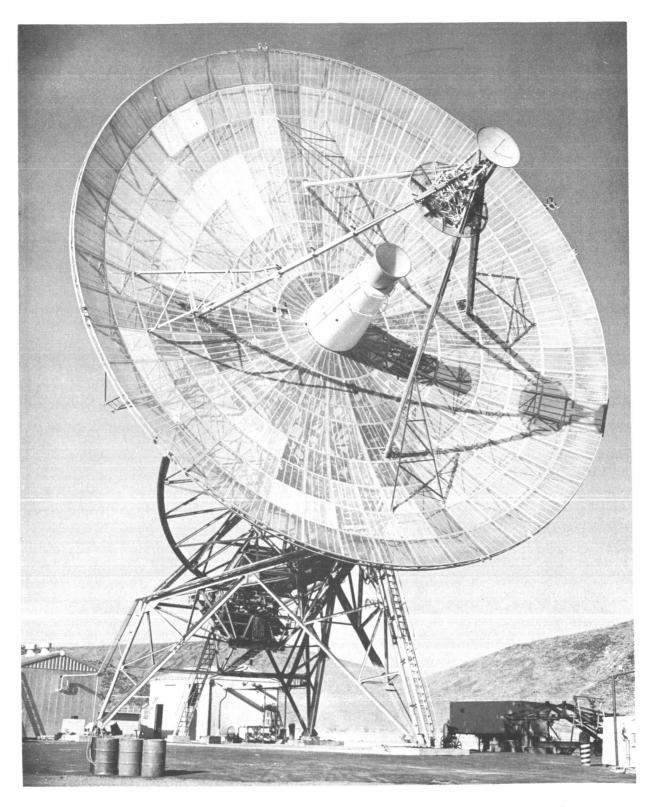


Fig. 15 a. The Deep Space Instrumentation Facility, Goldstone, California 85-ft. dia. Polar Mount Antenna

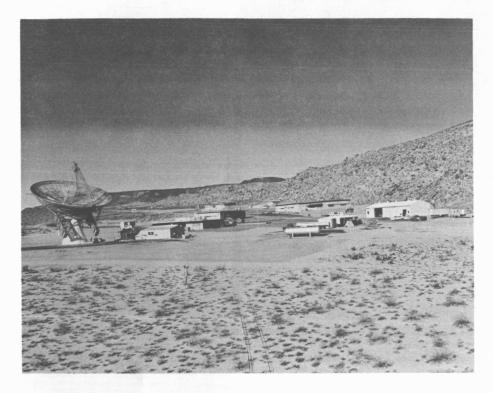


Fig. IV-15 b. Goldstone Deep Space Station

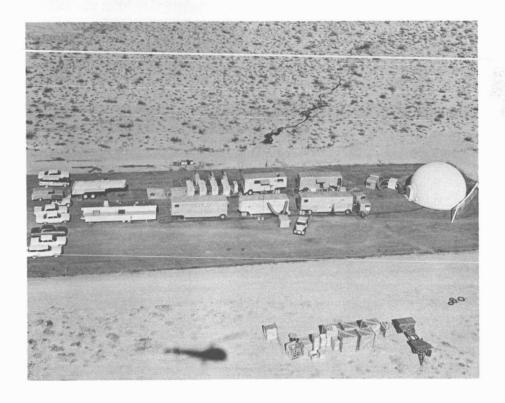


Fig. IV-16. Mobile Tracking Station





F. SPACE FLIGHT OPERATION FACILITY (SFOF)

The SFOF to be used with Mariner Rwas developed for the Ranger Program to assimilate, manipulate, analyze, and evaluate data received from the spacecraft. It also prepares command data for transmission to the spacecraft and readable experimental data for the scientific community.

The data received from the spacecraft may be divided into two basic types, tracking data and telemetry data. The tracking data is fundamental but not unique to the orbit determination process: subsidiary information concerning performance of the spacecraft — Earth communication system is also obtained. The telemetry data affords the means to evaluate spacecraft performance and obtain the results of the scientific experiments. Data transmitted to the spacecraft are in the form of commands which affect some aspect of the future course of the mission. Whether these types of data must be handled in real-time and near-real-time or non-real-time is a major factor in the design of the SFOF. That portion of the tracking and telemetry data which affords information from which commands are generated and executed and which is essential to the immediate operation of the ground instrumentation must be handled in real-time. The data handling facilities required for real-time data processing must be highly reliable and extremely flexible yet perform a relatively small portion of the total data processing. The use of the facilities which are to process the majority of the information must be carefully programmed but once determined becomes relatively static for a given mission.

The complex which has been developed to perform the functions outlined above is comprised of four principal parts:

- 1) The Central Computing Facility, CCF, located at JPL, Pasadena, California. An IBM high-speed automatic digital computer utilized as the major information transforming device forms the nucleus of the CCF. Considerable subsidiary and paripheral equipment is available in the CCF for handling, collating, sorting, and displaying the data. All real time data processing required in the Mariner R project will be performed in the CCF. All orbital calculations and reductions of telemetry data will be performed in the CCF.
- 2) The connections to the Deep Space Instrumentation Facility (DSIF). Each of the three permanent tracking stations which make up the DSIF is connected to the JPL Communications Center in Pasadena, California by teletype and telephone. The JPL Communications Center can then connect directly into the Computer Facility or to other stations in the DSIF. The Mobile Tracking Station will be connected through the South Africa permanent station.
- 3) The JPL Communications Center located at JPL, Pasadena, California. The JPL Communications Center forms the hub of the communication network over which tracking, telemetry and command data are transmitted within the data handling complex. Control of the data flow is exercised from the communications center.
- 4) The Data Reduction Facility, DRL, located at JPL, Pasadena, California. The DRL reduces and prepares the magnetic tapes on which all spacecraft telemetry is recorded for the IBM 7090 Computer. Real time data processing will not be done in the DRL for the Mariner R project. The tracking data required for real time orbit determination will be forwarded to the CCF via teletype from each DSIF site. At the CCF these data will be analyzed and reduced, the orbit determined and prediction and acquisition information supplied to the DSIF. The spacecraft telemetry, required for command purposes and associated performance evaluation will be transmitted in the same manner and reduced by the CCF.

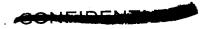


The scientific data recorded on magnetic tapes at each antenna site will be transported to the JPL Telemetry Data Reduction Laboratory (teletype transmission will also be used), where the signals will be demodulated from the carrier frequency and the noise will be removed. Also, the magnetometer frequency data and the Lyman-alpha analog data will be transformed into digital data for each 0.1 or 0.01 second period. All digitized data will then be transformed by a specially built data translator and recorded on a magnetic tape that can be fed directly into the computer.

In order to correlate the data with the position of the vehicle, those parameters which give the initial trajectory conditions will be fed into the system. When used in conjunction with the trajectory computer program, these parameters give the desired positions at any time.

The computer accepts this information serially into its memory. The first operation is to check the data to determine whether or not they pass certain parity tests and frame-synchronization markers inherent as check points in the transmitted data. Once it is established that the data are correct, calibration factors are applied to each experiment in order that the numbers will be of significance to the reader. Since many of the experiments use counters which accumulate information rather than reset each time, the computer calculates successive differences between readings and also calculates averages, ratios, and other desired parameters. The computer also makes comparisons with the results of other experiments.

An output format is created which labels each experiment and gives the time the data were received in the spacecraft. All of the transformed data will be printed numerically on the IBM tabulator.





SECTION V

MANAGEMENT PLAN

A. APPROACH

1. Assignment of Management Responsibilities

The Jet Propulsion Laboratory is assigned project management responsibility for the Mariner R project. JPL is also assigned system management responsibility for the Mariner R spacecraft system including the associated complex for post-injection space flight operations.

MSFC is assigned system management responsibility for the Agena B launch vehicle system including vehicle procurement, space vehicle systems engineering and integration, launch operations, and launch-to-injection tracking and instrumentation.

Detailed divisions of responsibility are indicated in the attachments to this PDP. A summary of the responsibilities is shown in Figure V-1. A list of the key personnel involved in the Mariner R project, indicating their functions, is shown in Table V-1.

2. Management Organization

a. National Aeronautics and Space Administration

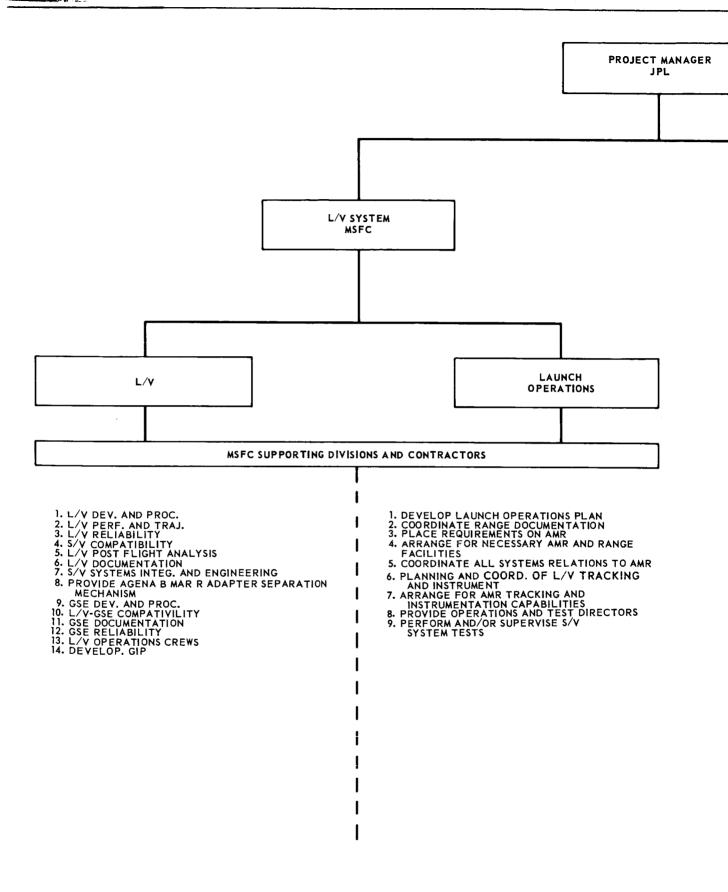
The NASA Headquarters' responsibilities for the Mariner R project are assigned to F. D. Kochendorfer of the office of the Director of Lunar and Planetary Programs (Oran W. Nicks) under the overall direction of the Office of Space Sciences (Homer E. Newell, director, and E. M. Cortwright, deputy). Figure V-2 is an organization chart showing these offices.

b. Jet Propulsion Laboratory

The Mariner R project will be managed within the structure of the Planetary Program Office. Figure V-3 is an organizational chart of the Jet Propulsion Laboratory.









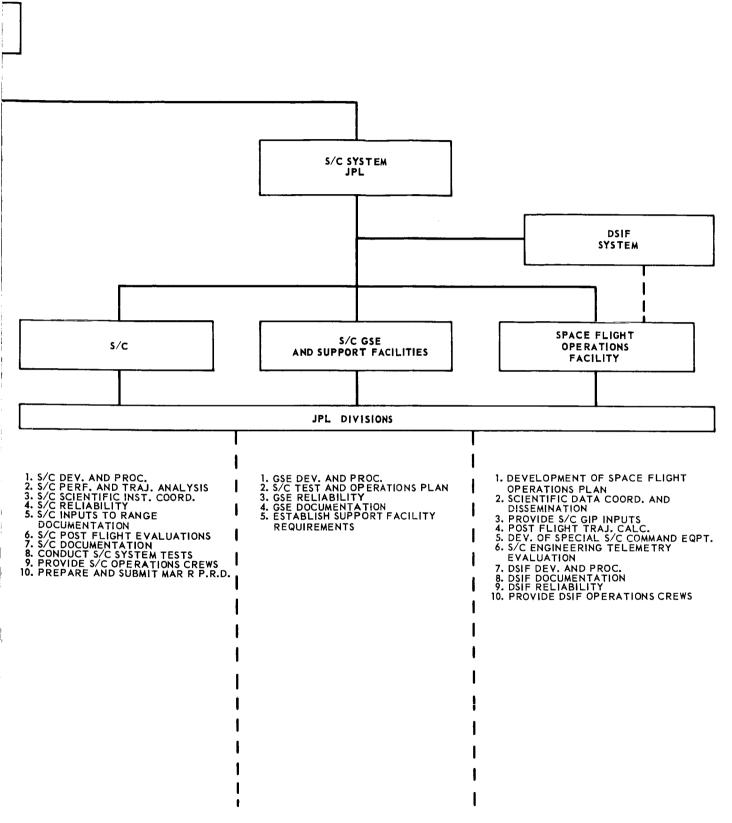


Fig. V-1. Responsibilities Assignment Chart for the Mariner R Project



TABLE V-1 LIST OF KEY PERSONNEL IN MARINER R PROJECT

Jet Propulsion Laboratory — Telepho	Tel. Extension	
JPL Director	PL Director Dr. W. H. Pickering	
JPL Deputy Director	B.O. Sparks	401
Planetary Program Director	R. J. Parks	788
Mariner R Project Manager	J. N. James	701
Assistant Project Manager	W. A. Collier	764
Staff	P. N. Haurlan	1570
Fiscal Assistant	F. Fairfield	434
Systems Division Assignments		
Project Coordination	V. J. Magistrale	2715
Project Liaison	S. R. Schofield (J. T. Ofer)	589
Spacecraft	D. Alcorn (D. Schneiderman)	1210
Spacecraft/Vehicle Integration and Members of Vehicle Integration Panel	J. Q. Spaulding (H. J. Margraf)	1823
Ground Support Equipment & Facilities	M. A. Piroumian	776
Assembly and Operations	M. T. Goldfine (A. Nalbandian)	2487
Members of Operations Panel	J. F. McGee (H. M. Levy)	1141
Space Flight Operations	M. S. Johnson	1389
Quality Assurance	J. M. Yamashiro	2471
Testing	J. Maclay	1351
Program Requirements Document	P. W. Barnum	1731
Members of Performance Panel	C. R. Gates (C. G. Pfeiffer)	1301
Project Representatives		
Guidance and Trajectory	E. Cutting	1338
Cabling	W. F. Gill	2329
Space Science	J. Martin (I. Walenta)	431
Chairman of Tracking, Comm., and Telemetry Panel	J. F. Koukol	723
Telecommunications	T. C. Sorensen (R. Harker)	1804
Guidance and Control	T. S. Bilbo	2438



TABLE V-1 LIST OF KEY PERSONNEL IN MARINER R PROJECT (cont) Tel. Extensio				
	Engineering Mechanics	J. H. Wilson	470	
	Engineering Facilities	K. Zebb	1866	
	Propulsion	W. W. Smith	1403	
2.	Marshall Space Flight Center (Huntsvil	le, Ala.) Telephone JEfferson 6-4	411	
	Agena Project Manager	F. Duerr	876-4134	
	Program Control	C. Deneen	876-3829	
	Vehicle Integration	J. D. Odom	876-3633	
	Chairman of Performance Panel	J. L. Stamy	876-1801	
	Chairman of Operations Panel	C. M. Cope		
3.	Marshall Space Flight Center (Sunnyva	le, Calif.) Telephone REgent 9-43	21	
	Technical Representative	R. E. Pace, Jr.	25725	
	Ass't. Tech. Rep.	E. Lowrie	25725	
	JPL Liaison	A. Hughes	23059	
	NASA Peculiar Tests	D. B. Brame	23059	
	Vehicle Surveillance	A. B. Triche	23050	
4.	MSFC Representative at AFSC/SSD Te	elephone OSborne 5-0351 V. G. Cummins	43	
5.	AFSC/SSD - Telephone OSborne 5-035	1		
	Ranger Directorate	Major J. Albert	43	
	Chief Engineering Branch	Major C. Wurster	43	
	Project Officer, Lunar Mission	Lt. A. Vogan	43	
	Project Officer, Spacecraft	Lt. B. Johnson	43	
6.	Lockheed Missile Systems Company -	Telephone REgent 9-4321		
	NASA Program Manager	H. T. Luskin	23282	
	Ass't. Program Manager	D. R. Latham	25891	
	NASA Program Technical Staff	F. D. Albright	25454	
	Chief Project Coordinator	R. W. Dodds	25080	
	Manager NASA Program Requirements	T. E. Wedge	23834	
	Mariner/Agena Coordinator	E. Parkinson	25486	
	Performance	C. Skladal	25892	
	Vehicle Requirements Supervisor	G. Chippendale	25892	



TABLE V-1	ABLE V-1 LIST OF KEY PERSONNEL IN MARINER R PROJECT (cont)		
	Subsystem A, Lunar (Airframe) W. Trask		25892
	G.S.E.	J. A. Gilmore	25912
	Flight Test Data, C & C	D. Johnson	25754
	Subsystems C & D	F. N. Boice	23553
	Reliability	E. McCaba	23922
	peration and Test Requirements upervisor	H. J. Ballard	25912
NASA	Project Engineer	J. J. Kennelly	25582
St	ubsystem A (Airframe)	O. E. Brandt	27420
Su	ubsystem B (Propulsion)	J. L. Grubbs	22027
St	ubsystem C (Elec. wiring)	M. Schwartz	28402
St	ubsystem D	T. J. Tracy	28570
S	ystems Integration	M. L. Mercer	25373
C	omm. and Control	W. B. McCabe	28570

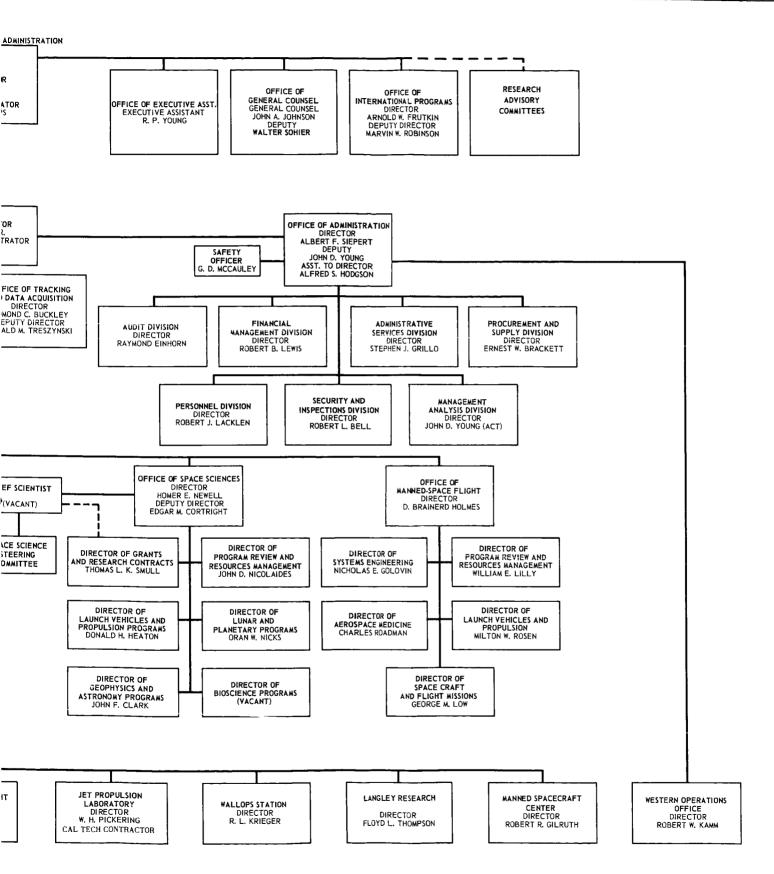
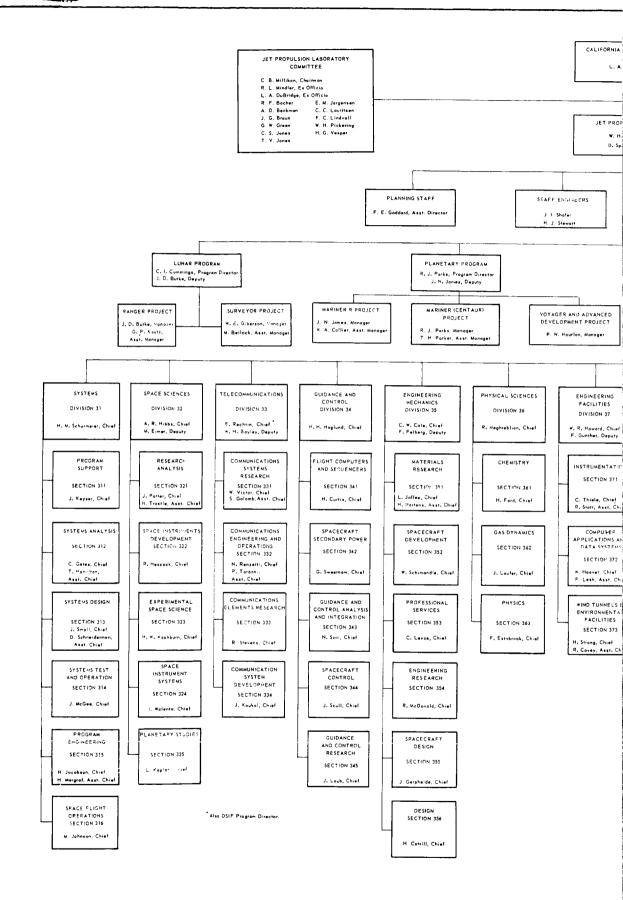


Fig. V-2. National Aeronautics and Space Administration

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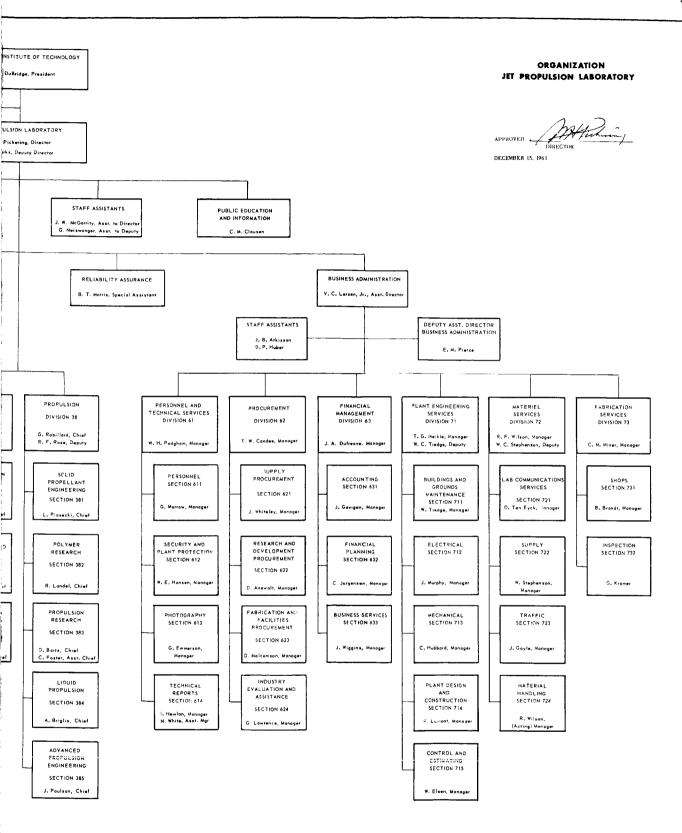


Fig. V-3. Jet Propulsion Laboratory Organization Chart



c. Marshall Space Flight Center

The George C. Marshall Space Flight Center is assigned responsibility for the over-all management and conduct of the launch vehicle portion of the Mariner R project. In particular, this assignment includes administrative and technical responsibility from vehicle procurement through launch and tracking to spacecraft injection. Figures V-4 through V-6 indicate the organizational structure at MSFC.

(1) Vehicle System Responsibility

The Director, MSFC, in order to assume management cognizance of the Agena B and Centaur projects, has established as his principal agent a Light and Medium Vehicle Office directed by Mr. Hans Hueter. It is his responsibility to assure proper vehicle support to the several space projects, including Mariner R, which utilize these vehicles along with procurement and proper coordination with Air Force boost vehicles, such as Atlas, to be utilized on Mariner R. In order to support the Mariner R project, as well as others utilizing the Agena B vehicle, an Agena B Systems Manager, Mr. Friedrich Duerr, has been appointed within this organization. Mr. Duerr is responsible for the planning and execution of the approved Agena B vehicle projects, including procurement, modification, GSE, planning and implementation of launch-to-injection, tracking, and instrumentation, and certification of performance and reliability analysis. The assigned responsibility includes insuring the integrity and performance of the launch vehicle and spacecraft for proper mating of these systems necessary for the successful injection of the spacecraft. This includes facilities and ground support equipment for the various phases of manufacturing, testing, and launch preparation. In view of the contractual arrangements for launch vehicles, the activities of the prime and subcontractors are directed by Mr. Duerr through the Air Force Space Systems Division.

(2) Launch Operations Responsibility

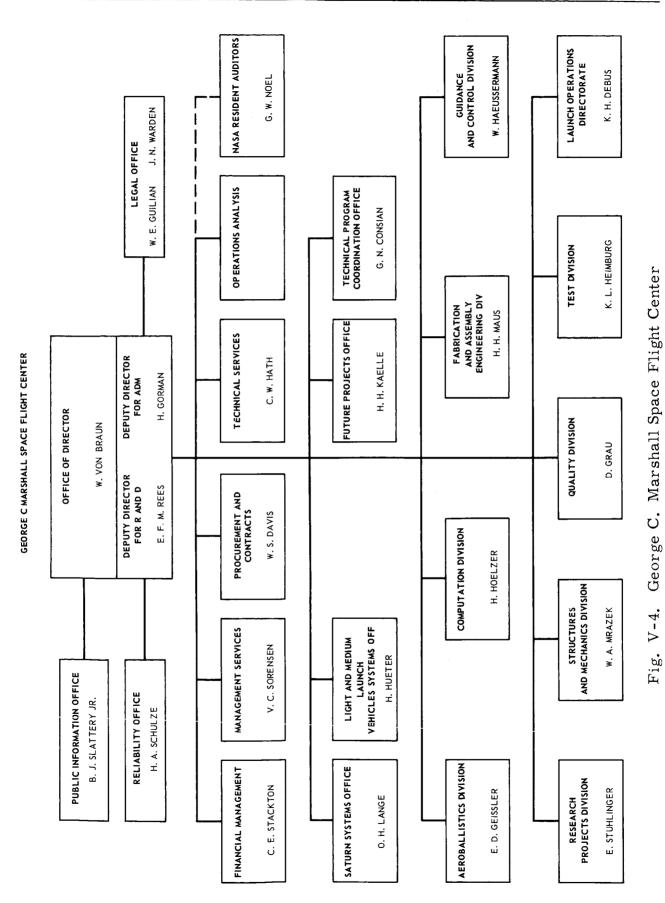
Within Marshall Space Flight Center, LOD has been assigned responsibility for NASA launches in accordance with Marshall Manual 2-2-9 dated 1 July 1960. For the project assigned to the Light and Medium Vehicle Office, LOD will perform the launch operations in response to program requirements and objectives as specified by the Agena B Systems Manager. LOD Director, Dr. Debus, has designated within LOD Mr. Charles Cope for the NASA Agena B Coordinator. The NASA Agena B Systems Manager will place requirements with LOD through Mr. Cope. He reports to Mr. Duerr in such matters as meeting program objectives, scheduling, and expenditures. Administratively and operationally Mr. Cope reports to the Director, LOD.

3. External Organizations Involved in the Project

a. Air Force Space Systems Division (AFSSD)

Responsibility for procurement together with logistic and management support to meet NASA Agena launch schedules is assigned to the USAF. AFSSD will be responsible for operational, administrative, and technical support for NASA Agena launch vehicles. This shall include personnel and facilities in support of launch operations. AFSSD will act as agent for MSFC in contract procurement of launch vehicles in accordance with USAF procedures except as modified by NASA regulations and policy or by law. The SSD Director for NASA Agena project (Major J. Albert) is the normal USAF point of contact for SSD operations associated with the NASA Agena project. See Figure V-7.





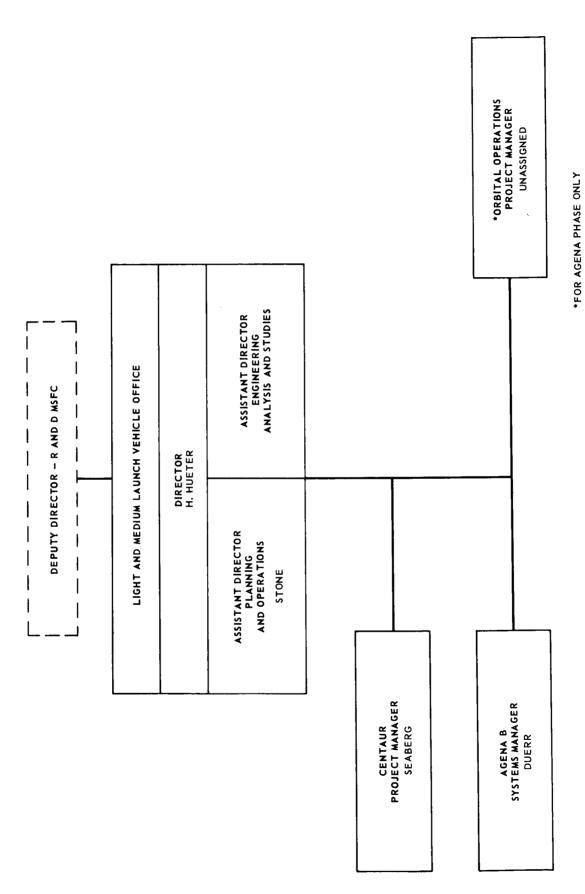
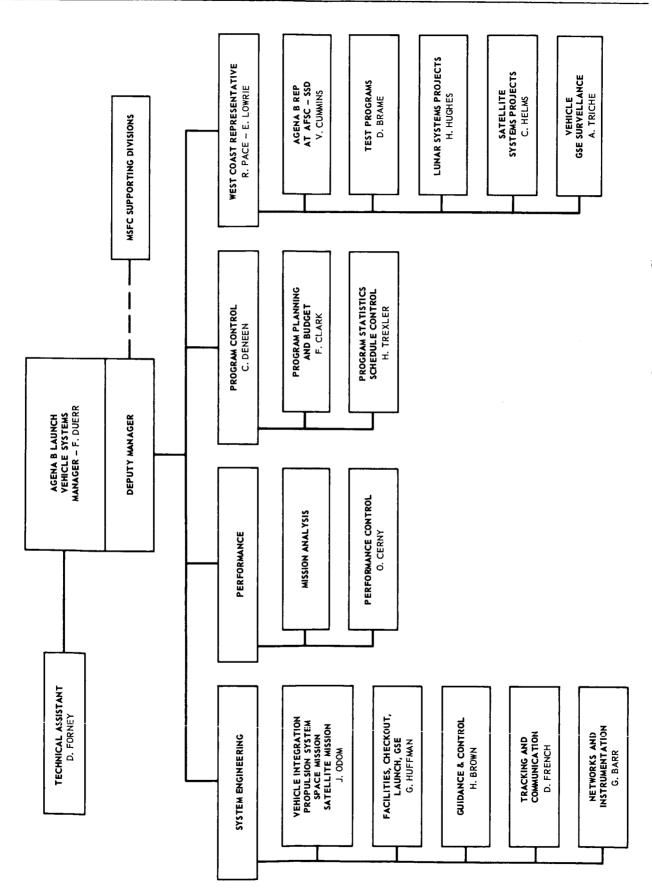


Fig. V-5. MSFC Systems Support, Equipment Division, Light and Medium Launch Vehicle Office





Agena B Launch Vehicle System Organization Chart Fig. V-6.

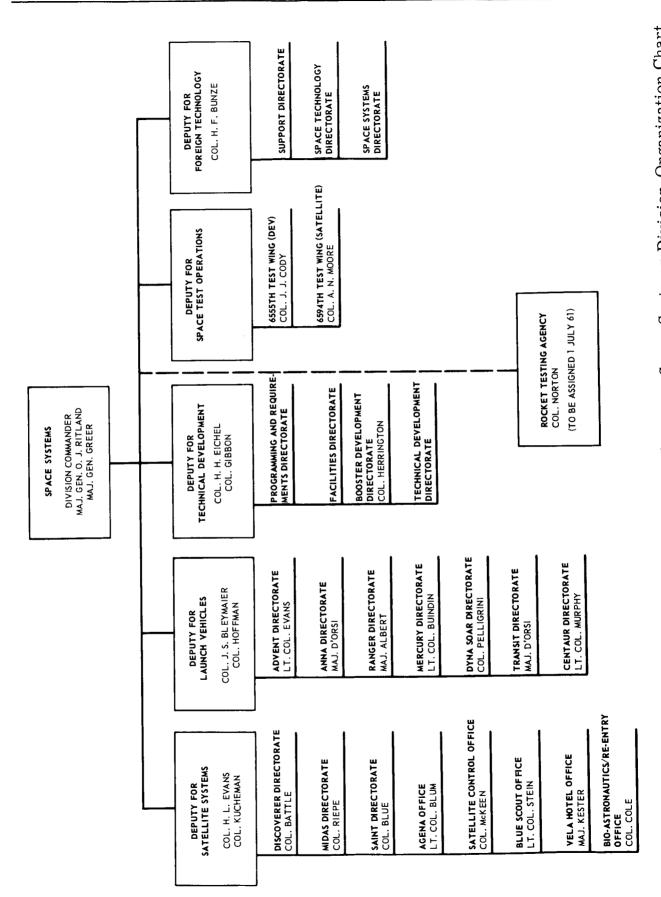


Fig. V-7. Air Force Systems Command, Aerospace Systems, Space Systems Division-Organization Chart

b. Lockheed Missile System Company (LMSC)

Within LMSC the NASA Agena project is managed by a Program Office headed by Mr. H. T. Luskin. The MSFC Plant Representative's office, Mr. Luskin, and a portion of the LMSC staff active on the project are located together for ease of communication. In 1960, LMSC "projectized" its organization to increase the responsiveness of the various technical groups contributing to the program. Figure V-8 shows the LMSC organization supporting the NASA activities, including the Mariner R project.

4. Permanent Project-wide Bodies

In order to utilize the relationships on Ranger/Agena to the maximum extent possible, the same board and panels as exist in the Ranger project will be used in the Mariner R, for the same purpose of servicing as technical advisers to the project and system managers.

a. Agena B Coordination Board

This board was appointed at the start of the Ranger project to coordinate the vehicle requirements of the various uses of the Agena B vehicle and to provide a mechanism for the settlement of interagency problems. The present board composition is as follows:

J. L. Sloop	NASA	Chairman
D. L. Forsythe	NASA	Deputy Chairman
B. Milwitsky	NASA	Lunar Program Director
J. L. Mitchell	NASA	-
W. Jakobouski	NASA	
F. Duerr	MSFC	Agena B Systems Manager
J. D. Burke	\mathtt{JPL}	Ranger Project Manager
J. N. James	\mathtt{JPL}	Mariner R Project Manager
E. A. Rothenberg	GSFC	

b. Vehicle Integration Panel - F. Duerr, Chairman

This group shall continually monitor, compile, and evaluate the structural, network, and configurational problems as they relate to the interface between the spacecraft and vehicle with shroud. The panel will also be responsible for the interface aspects of the launch checkout procedure.

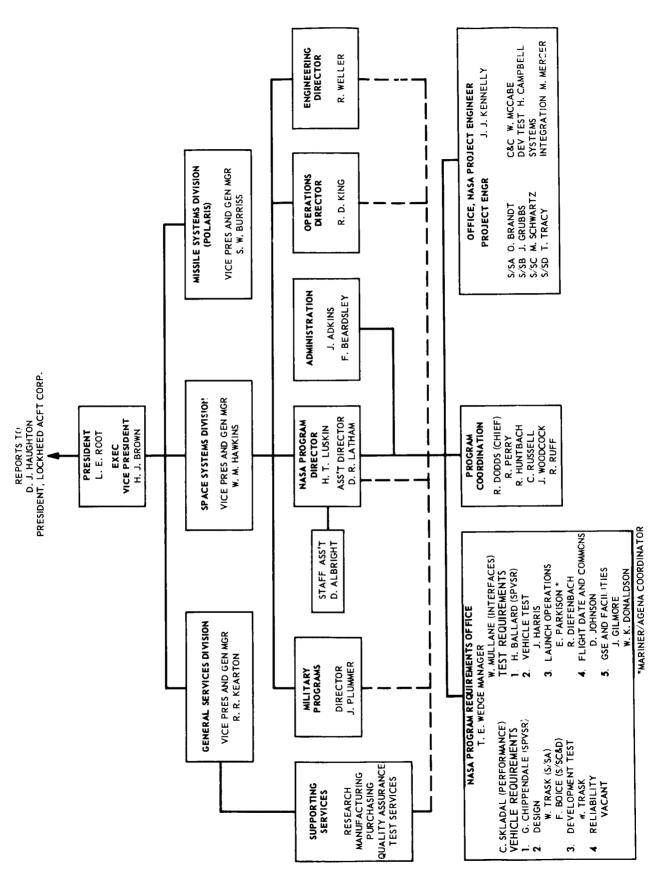
c. Performance Control, Trajectories, Guidance and Control, and Flight Dynamics Panel - J. L. Stamy, Chairman

This panel will continually monitor, compile, evaluate, and coordinate data relating to performance, trajectories, guidance and control, and flight dynamics as they interact with the vehicle (with shroud) and spacecraft interface.

d. Tracking, Communication, In-Flight Measurements and Telemetry Panel - J. F. Koukol, Chairman

This group shall continually monitor, compile, evaluate, and coordinate data relating to tracking, communications, in-flight measurements and telemetry as these items interact with the vehicle (with shroud) and spacecraft.





V-8. LMSC Organization Supporting the Mariner R Project Fig.

e. Atlas/Agena B Flight Test Working Subgroup

This group shall act as the prime mechanism for coordinating flight preparations. Members of this group will participate in vehicle and range readiness meetings, culminating at T-minus 1 day, at which time the Launch Operations and Test Director (Dr. K. H. Debus) assumes over-all control with AFSSD assistance.

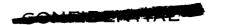
5. Reports

Due to the limited time available to the Mariner R project, it is anticipated that most of the required liaison between Headquarters, Project Manager, system managers, and major contractors will take the form of meetings, telephone calls, and TWX messages. Emphasis will be placed on generating and distributing adequate meeting minutes to keep all key personnel informed. In addition there will be prepared JPL bimonthly Space Program Summaries, LMSC Monthly Status Reports, and documents as required by AFBM 58-1. Table V-2 lists the flight evaluation documents to be generated.

TABLE V-2. LIST OF FLIGHT EVALUATION DOCUMENTS FOR THE MARINER R PROJECT

TITLE	TYPE	TIME REQ'D (post launch)	RESPONSIBILITY
Five Hour TWX	TWX	5 hours	GD-A (AMR)
Flash Report	TWX	8 hours	LOD/FTWG (AMR)
Prelim. Spacecraft Operations Letter	Letter	18 hours	JPL (Pasa.)
Prelim, Test Results	Publication	24 hours	GDA (SD)
Ascent Guidance Quick	Publication	2 days	GE (AMR)
Look Report			
Final Data Report	Publication	4 days	LMSD (SV)
Flight Test Report	Publication	10 days	GDA/FTWG (AMR)
Prelim. System Test Report	Publication	10 days	LMSD (SV)
Final Launch Report	Publication	1 5 da ys	LOD/FTWG (AMR)
Field Operations Memo	Publication	21 days	JPL (AMR)
Flight Test Evaluation Report	Publication	21 days	GD-A (SD)
Ascent Guidance Evaluation	Publication	30 days	GE (SYR)
Space Flight Operations Memo	Publication	30 days	JPL (Pasa.)
Tracking Operations Memo	Publication	30 days	JPL (Pasa.)
Combined System Test	Publication	35 days	LMSD (SV)

NOTE: FTWG denotes "Flight Test Working Group."





B. SCHEDULE

A schedule reporting structure for the Mariner R project is shown in Figure V-9.

The schedules indicated are the schedules used by the project manager to effect control over the project. Reports on these schedules will occur during frequent meetings within and between systems meetings and will be contained in the published minutes.

The PMP report to headquarters is based directly on these schedules, and as such constitute a PMP package which reflects the entire Mariner R project.

Reports on the actual milestones contained in the PMP charts are the responsibility of the respective system managers, and as such must be submitted to the project manager by the close of the work day on the Wednesday which constitutes the end of the normal PMP report period (two week period, Wednesday to Wednesday). These reports may be sent via telephone and/or TWX or letter.

The project manager will then submit to headquarters the integrated Mariner R project PMP package. These will be submitted to arrive at headquarters by Monday following the closing Wednesday of the respective report period. (See chart 1.)

A sample project report package is enclosed as Figures V-10 through V-21. Additions, deletions or changes will be made as required and deemed necessary by agreement between the project manager and the headquarters program chief.

With this system of the system managers reporting to the project manager via a PMP report (see chart 2), it is recognized there may be some duplication in reporting due to the Agena Vehicle involvement with projects other than Mariner R and a possible requirement for MSFC to report as a total Agena project. It is felt, however, that it is essential to have the Mariner R PMP package as a complete report in itself.

CHART 1

PMP REPORT SEQUENCE

Wednesday Closing day for information to be reported.

System Manager reports to Project Manager on status of applicable

milestones.

Friday Project Manager submits by mail the Mariner R PMP package to

Headquarters.

Monday Mariner R PMP package arrives at Headquarters.

Tuesday Headquarters updates Mariner R PMP's in accordance with infor-

thru mation received from Project Manager and prepares new mailing

Friday for distribution to Centers and Agencies.

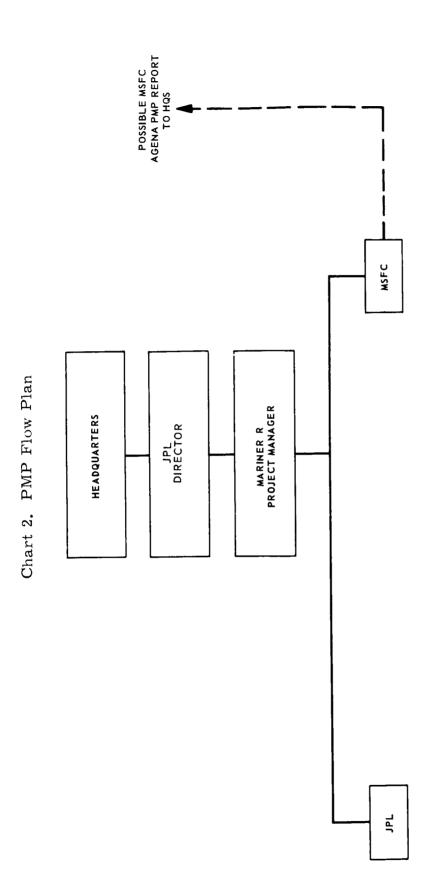
Tuesday Updated Mariner R PMP's arrive at all Centers and Agencies on

distribution list.



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Mariner R Project Schedule Reporting Structure Fig. V-9.



LAUNCH VEHICLE, ATLAS AGENA B FOR P 37 LAUNCH VEHICLE, ATLAS AGENA B FOR P 38 LAUNCH COMPLEX 12 LOADING

SPACECRAFT/VEHICLE INTEGRATION INTEGRATED FACILITIES LAUNCH BASE OPS DOCUMENTATION TRAJECTORIES

SPACECRAFT ASSEMBLY AND OPS SPACEFLIGHT OPERATIONS COMPLEX

SPACECRAFT GSE AND GSF

SPACECRAFT P 37, 38

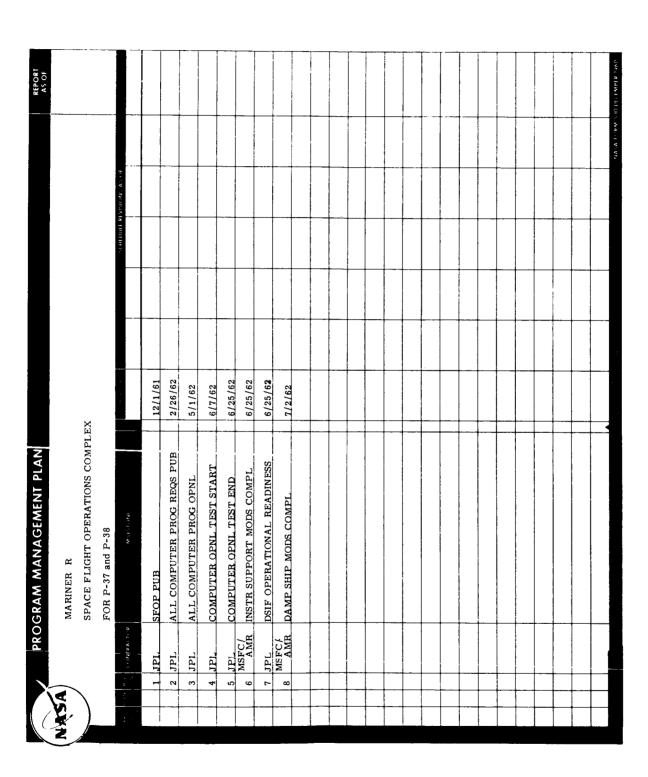


Fig. V-10. Space Flight Operations Complex



PRC	OGRAM MANAGEMENI PLAN			 AS OF
	MARINER R			
	SPACECRAFT ASSEMBLY AND OPERATIONS	TIONS		
	FOR P-37 and P-38			
A CONTRA I	By Table		SOHERIERRANIONS AS OF	
1 JPL	ASSEMBLY & OPNS PLAN PUB	1/2/62		
2 JPL	START ASSEMBLY MR-1	1/15/62		
3 JPL	START ASSEMBLY MR-2	1/29/62		
_	MR-1 SYSTEM TESTS COMPL	3/23/62		
5 JPL	MR-2 SYSTEM TESTS COMPL	4/6/62		
6 JPL	FIM PUB	5/1/62		
	MR-1 DUMMY RUN COMPL	5/11/62		
8 JPL	SHIP MR-1 TO AMR	5/29/62		
— —	SHIP MR-2 TO AMR	5/30/62		
	P-37 SPACECRAFT ON PAD	6/28/62		
11 JPL	P-38 SPACECRAFT ON PAD	7/24/62		
-				

V - 20

X	TKO	FROGRAM MANAGEMENI PLAN					REPORT AS OF
NASA		MARINER R					
		SPACECRAFT GROUND SUPPORT EQUIP & GROUND SUPPORT FACILITIES	UIP & GROUND SUP	PORT FACILITI	ES		
		P-37 and P-38					
10 P	CONTRA-TOR	ikorshw			VONERUITE REVENIENT, AN OR		
	JPL	DELSC HANDLING EQUIP TO SAF	1/8/62				
2	JPL	DEL STC-1 TO SAF	1/22/62				
3	JPL	DEL STC -2 TO SAF	2/5/62				
4	JFL	DEL LCE-1 TO SAF	4/16/62				
5	JFL	DEL GSE TO SCF AT AMR	6/4/62				
9	JFL	SCE EQUIP & GSE INST & CO	6/18/62				
7	JPL	DEL GSE TO LC 12	6/18/62				
80	MSFC/ JPL	LC-12 EQUIP & GSE INST & CO	6/18/62				
						-	
			1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1			NASA FORM SH	NASA FORM S ID DELEMBER DAG

Spacecraft Ground Support Equip & Ground Support Facilities Fig. V-12.

	PRC	PROGRAM MANAGEMENT PLAN				REPORT AS OF
ASSA		MARINER R				
		SPACECRAFT				3-m4
		FOR P-37 and P-38				
	. 94.4			2000		
1	JPL	S/C FUNCT SPECS REL	19/6/01			
2	JPL	S/C SCHEMATICS COMP & LISTED	1/15/62			
3	JPL	DESIGN FREEZE - INTERFACES	10/16/61			
4	JPL	DESIGN FREEZE - TOTAL	12/15/61			
2	JPL	MR-1 USE-HDWE DEL TO SAF COMP	1/15/62			
9	JPL	MR-2 USE-HDWE DEL TO SAF COMP	1/29/62			
-						
-						
					,	
					3	× 1444

Fig. V-13. Spacecraft

	PRO	PROGRAM MANAGEMENT PLAN						REPORT AS OF
ASA		MARINER R						
)		LAUNCH BASE OPERATIONS						
		FOR P-37 and P-38		9				
1.0	With a substitute to the	two return			\$ OHE DOTE	CONFRONT ACTO		
	1 MSFC	ATLAS ON PAD						
2	2 MSFC	AGENA ON PAD	6/27/62					
	3 JPL	S/C ON PAD	6/28/62					
4		J FACT COMPL	7/3/62					
5		LAUNCH P-37	7/19/62					
9	6 MSFC	ATLAS ON PAD						
7	7 NSFC	AGENA ON PAD	7/24/62					
80	8 JPL	S/C ON PAD	7/24/62					
65	6	J FACT COMPL	7/27/62					
10		LAUNCH P-38	8/9/62					
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Fig. V-14. Launch Base Operations

Section V

10/2/61 12/11/61 11/27/61 11/22/61 11/5/62 5/21/62 5/21/62 6/18/62 6/18/62		PKO	TROOPEN MAIN MAIN ACCIDENT LEAN				AS OF
John Porumentation Porumentation	1		MARINER R				
1 JPL			DOCUMENTATION				
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PREIL PDP PUB							
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MSFC GEN INST PLAN PUB MSFC FLT TERM REPORT PUB MSFC DETAIL TEST OBJECTIVES PUB MSFC OPS REGS SUBMITTED TO AMR MSFC MANGE SAFETY REPORT PUB MSFC RANGE SAFETY REPORT PUB MSFC MANGE SAFETY REPORT PUB MSFC MANGE SAFETY REPORT PUB MSFC MANGE SAFETY REPORT PUB MSFC MSFC MSFC MSFC MSFC MSFC MSFC MSFC	2	SZ .	PROG SUPPORT PLAN PUB	2/1/62			
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Fig. V-15. Documentation

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	FOR P-37 and P-38				
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4 MSFC	AE BENEFICIAL OCCUPANCY	4/15/62			
5 MSFC	AE TURN KEY OCCUPANCY	6/3/62			
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Fig. V-16. Integrated Facilities



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1 JPL	INTERFACE SPEC PUB	10/2/61			
2 MSFC/ JPL	PREL MATCH MATE TEST COMPL	11/8/61			
MSFC/	S/C SEPARATION TEST COMPL	12/13/61			
	ADAPT STRUCT TEST COMPL	1/2/62			
5 MSFC/ JPL	COMBINED VIBRATION TEST COMPL	1/15/62			
6 MSFC/ JPL	COMM INTERFACE TEST COMPL	1/22/62			
7 MSFC	DEL ADAPTER MOCKUP TO JPL	4/13/62			

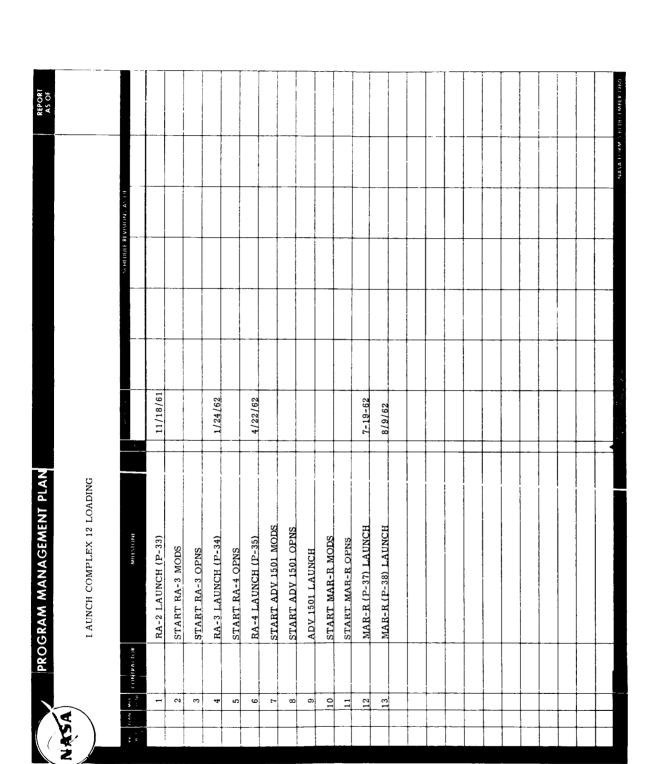


Fig. V-18. Launch Complex 12 Loading

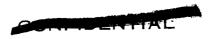


Fig. V-19. Atlas (Ser No.) - Agena B (Ser No.) Launch Vehicle Schedule

MARINER R ATLAS (Ser No.) - AGENA B (Ser No.) LAUNCH VEHICLE SCHEDULE FOR P-38 MARINER ELEASES COMPL AGENA FINAL ASSY INITIATED AGENA FINAL ASSY COMPLETE AGENA SYSTEMS TEST INITIATED AGENA SYSTEMS TEST INITIATED ATLAS DELIUER TO AMR ATLAS DELIUER TO AMR ATLAS DELIUER TO AMR ATLAS DELIUER TO AMR AGENA ON PAD AGENA ON PAD AGENA ON PAD	REPORT AS OF																					
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Fig. V-20. Atlas (Ser No.) - Agena B (Ser No.) Launch Vehicle Schedule

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SECTION VI

PROCUREMENT MANAGEMENT ARRANGEMENTS

A. APPROACH

- 1. The only major project element in the Mariner R project to be accomplished through contract will be the procurement and operation of the Agena B launch vehicle.
- 2. JPL and MSFC are each assigned full procurement responsibility including contract administration and technical monitoring in their respective areas of system management. Detailed procurement planning and the actual execution will be taken in accordance with NASA procurement regulations 18-3.8 and, in the case of JPL, with the requirements of contract NASw-6.
- 3. A schedule of major contracting milestones is incorporated into master schedules shown in Section V, Paragraph B of this Project Development Plan.

4. Organizational Arrangements

- a. Procurement organizational arrangements at JPL are as follows: Procurement requisitions and accompanying statements of work are originated by the applicable Technical Division and reviewed by the Project Manager and the Laboratory Deputy Director. The requisitions are then negotiated by the Procurement Division within the requirements of NASA Contract NASw-6. Procurements are technically monitored by the cognizant Technical Division and administered by the Procurement Division. Monthly fiscal and technical progress reports are required of each subcontractor.
- b. In order to achieve the control and supervision required for MSFC to properly discharge its responsibilities in launch vehicle and launch-to-injection system procurement, while at the same time taking full advantage of established AFSSD procedures and contractor relationships, the following general procedures apply:
- (1) Direct contact and liaison between authorized MSFC and JPL representatives and associated contractors will take place as required to discuss technical matters.
- (2) Technical direction of contractor engineering for NASA peculiar requirements, within the scope of existing contracts, will be exercised by direct MSFC liaison with contractors. The MSFC representatives at SSD and the Plant Representative at Lockheed are the authorized representatives of the MSFC Vehicle System Manager for this function. Any action which is likely to affect the statement of work, cost, schedules and/or any other AF contracts at Lockheed will be handled through SSD.
- (3) Direction of contractors, outside the scope of existing contracts, will be implemented by MSFC through SSD in accordance with jointly approved procedures.
- (4) The MSFC Vehicle System Manager will be kept currently informed of actions by SSD or contractors which affect the configuration of vehicles, schedules, or operations involved in the procurement of NASA Agena B launch vehicles.
- (5) SSD will furnish MSFC with copies of all requests for proposals, contractor proposals, contracts, and amendments relating to the procurement of vehicles and support for NASA Agena vehicles and boosters. Accompanying endorsements and recommendations by SSD at their discretion are encouraged.





- (6) MSFC requirements will be placed on contract through individual contractual actions between SSD and contractors. Items procured and funds expended on MSFC tasks will be clearly identified and accounted for by respective contractors in fiscal reporting procedures.
- (7) Contractor documentation will, in general, conform to USAF requirements except specific requirements may be waived by MSFC subject to USAF concurrence. MSFC may institute additional documentation and reporting procedures to fulfill its needs. These will be coordinated with SSD and covering contractual action accomplished as necessary. Contractor documentation will be forwarded by the contractor through SSD with copies direct to MSFC and requires the approval of the MSFC Launch Vehicle System Manager prior to acceptance.
- (8) Inspections and tests required for acceptance of NASA vehicles and support equipment will be witnessed jointly by Air Force plant representatives and authorized MSFC and JPL representatives except where the requirements for NASA representation are waived by the MSFC Launch Vehicle System Manager.
- (9) Joint participation by SSD and MSFC will take place in discussions with contractors involving program management, fiscal matters, contracts, and negotiations. Direction of contractors in these areas will be implemented through SSD acting as agents for MSFC.
- (10) Engineering studies, test model fabrication, test and/or evaluations as may be required to support vehicle design and vehicle and spacecraft integration efforts will be directed by the MSFC Launch Vehicle System Manager, the Assistant Project Director at SSD and implemented through SSD.
- (11) NASA will reimburse the Air Force for costs associated with NASA requirements. USAF requests to NASA for funds will be accompanied by documentation on which the request is based. Contractor proposals with appropriate SSD endorsements and comments will be included where available. The initiating authority for expenditures or transfer to the Air Force of NASA funds in support of the NASA Agena Program is the MSFC Launch Vehicle System Manager.



SECTION VII

RESOURCE REQUIREMENTS

A. MANPOWER

Estimated manpower requirements for JPL are 485 man-years in FY 62 and 165 man-years in FY 63 estimated. MSFC manpower requirements are 6 man-years in FY 62 and 6 man-years in FY 63. DSIF manpower in support of the Mariner R project cannot be segregated from other projects and is included in the DSIF manpower allocations.

B. FACILITIES

1. Spacecraft Assembly Facilities

The assembly, component installation, checkout, and systems testing of the Mariner R spacecraft will be accomplished at the JPL Spacecraft Assembly Facility in Pasadena, California.

2. Environmental Test Facilities

The requirements for reliability and long life of the Mariner R spacecraft demand very complete and careful environmental test programs. For the Mariner R project the existing environmental test laboratory or those facilities under construction at JPL are adequate for performing the tests required.

3. Antenna Range

This facility located at JPL, is used for checkout of spacecraft communication antennas.

4. Chilao Flats

This facility, located above JPL in the San Gabriel Mountains, is primarily used for the checkout and calibration of the sun sensors to be used on Mariner R and other spacecraft. It also can be used for the checkout of the Earth sensors using the Moon as a target.

5. Table Mountain Facility

This facility is available for use in checkout of Mariner R spacecraft solar panels. It is owned by the Smithsonian Institution and located in the San Gabriel Mountains, approximately 50 miles east of the JPL location in Pasadena.

6. Celestial Simulator

This facility, located at JPL, is utilized in development, testing, and checkout of the attitude reference and control system of the Mariner R spacecraft.

7. JPL Computer Facility

The Laboratory replaced its IBM 704 computer facility with an IBM 7090 computer facility in December of 1960. The increased computer facilities are required for general laboratory computer





applications. However, the major growth of the computational load had been due to the space programs, including Mariner R.

The computation of space trajectories for preliminary design and for flight tables, orbit determination from observed tracking data and the reduction of telemetry data from the spacecraft are major problems requiring increased computational facilities. The computer is used in guidance and control systems design, structural design, temperature control analysis and most other areas of spacecraft design.

8. Deep Space Instrumentation Facility (DSIF)

Three stations presently comprise the DSIF: Goldstone, California; Woomera, Australia; and South Africa. In addition, the mobile tracking station, located close to the South African DSIF station, will be used for early spacecraft acquisition. The Goldstone station presently has command capability and the South African station will be modified for command in time for the Mariner R mission. The inter-station communication network consists of TTY and voice communication and will be tied together through JPL. Tracking data will be transmitted to JPL and processed by the 7090 computer, and acquisition information will be transmitted to the various stations.

9. AMR Spacecraft Facilities

The Mariner R facility requirements have been submitted to AMR through Program Requirements Document No. 3300. There are basically three sites, where work is proceeding preparatory to receiving and launching the spacecraft:

- a. Explosive Safe Facility. Necessary for handling of propellants and propulsion systems; this facility will consist of modifications and additions to the present NASA/JPL spin test facility.
- b. Launch Checkout Site. Consisting of a site for location of two checkout trailers, antenna tower, and collimation tower for communications system checkout prior to launch.
- c. Spacecraft Assembly and Test. Consisting of space in Building AE to accomplish the functions of:

Systems Test: A 3200 square feet high bay area, with provision for 35-foot hook height, and a 2550 square foot low bay area located in Building AE.

Scientific and Electronics Laboratories: Located on the other side of the high bay addition and consisting of 1900 square feet.

General Laboratory, Engineering and Administrative Office Space: Located in the north wing of Building AE and consisting of 4100 square feet of office space and 1200 square feet of general laboratory facilities. In addition, general storage space is provided in the central low bay of Building AE.

d. Launch Complex 12: For the purpose of on pad pre-launch and launch operations.

C. FUNDS

Estimated fund requirements for JPL are \$13.5 million for FY 62 and \$3.5 million for FY 63. Estimated funds for MSFC are \$16.5 million for FY 62 with no funds required for FY 63. Internal MSFC manpower costs are not included, in accordance with MSFC internal funding practices.



Some Ranger equipment will be used in the Mariner R project; cost of this equipment is included in the over-all cost of the Ranger project. DSIF costs for support of the Mariner R project cannot be segregated from other projects but are included in the DSIF operating costs.



SECTION VIII

COORDINATED OPERATIONS PLAN

The operations necessary to successfully achieve the goals of the Mariner R project can most adequately be described by defining the several major phases of the operations to be performed, as follows:

- 1. Systems assembly and operations to be performed by the various agencies, contractors and subcontractors in the preparation and checkout of their systems prior to shipment to AMR.
- 2. Prelaunch operations at AMR which are necessary to assure working and compatible systems prior to final mating of vehicles and spacecraft on the launch pad for launch.
- 3. Launch operations at the launch pad after the final mating of Atlas/Agena B and spacecraft, and including the launch-to-injection phase of flight.
- 4. The space flight or postinjection phase including all of the operations necessary to track and command the spacecraft and to acquire data. This phase also includes the handling and reduction of the data.

In order to accomplish the most efficient operation, each phase in the overall plan has a different character due to the changing participation of agencies, contractors and subcontractors. In each case, however, it is the responsibility of the project manager to assure that the operation runs smoothly and efficiently, with a minimum number of interface problems.

Each agency involved in the Mariner R project shall have definitive areas of responsibility. Figure VIII-1 shows the relationships among the operating groups. Those agencies involved in the management of the Agena B Launch Vehicle System and the AMR launch-to-injection facilities for the Mariner R project are the Marshall Space Flight Center (MSFC) including Launch Operations Directorate (LOD). USAF Space Systems Division (SSD), and Atlantic Missile Range (AMR). The principal contractors are Lockheed (LMSC) for the Agena B vehicles, system integration and Agena operations, General Dynamics-Astronautics (GD-A) for the Atlas boosters, and PAA and RCA for range operations. Flight missions are the responsibility of the Jet Propulsion Laboratory (JPL) who will supply the spacecraft, the postinjection tracking facilities (DSIF), and the Space Flight Operations Facility.

The Project Manager, who also performs the function of Mission Director, will be from the Jet Propulsion Laboratory. It will be the responsibility of the Project Manager to manage and settle interface problems among the systems within the Mariner R project. He shall have the responsibility and authority for mission decisions, for spacecraft preparation and for defining to the LOD criteria necesfor mission attainment. He shall participate in launch operations to insure mission readiness. No change in criteria, which will be suitably expressed in the Flight Test Directive, may be made without his consent.

The MSFC Launch Operations Directorate (LOD) will have the responsibility and authority for planning and execution of launch operations. This authority will be administered through the Launch Operations and Test Director.

The SSD 6555th Test Wing will act as the Agena B management group for the supervision of participating Air Force contractors at AMR. The Test Controller will be an officer of the 6555th Test



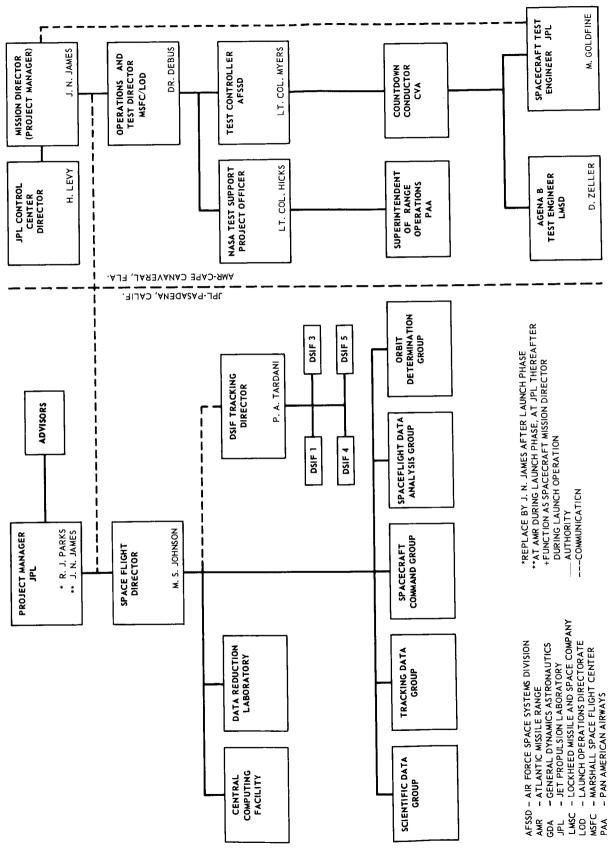


Fig. VIII-1. Launch Operations and Space Flight Organization



Wing and will control the countdown. The Countdown Conductor (GD-A) will supervise the over-all countdown of the total vehicle including the spacecraft. He will report to the Test Controller. The Lockheed AMR field group will be headed by the LMSC Station Manager. It will be the responsibility of this group to prepare the Agena B stage. Technical system integration of the Atlas-Agena B vehicle (including spacecraft interface) and participation in the countdown is also a part of this responsibility. The GD-A AMR Atlas Complex 12 group will be headed by the Test Conductor. This group's responsibility includes the preparation of the Atlas stage, and participation in the countdown.

The Spacecraft Test Engineer and his field crew (JPL) are responsible for the preparation of the spacecraft and participation in the countdown. It is the further responsibility of the Spacecraft Test Engineer to advise the Mission Director on spacecraft matters concerning the mission. The Space Flight Director (JPL) will also be responsible to the Project Manager/Mission Director on matters concerning readiness of the data handling complex.

Range requirements and conditions will be the responsibility of the Superintendent of Range Operations (PAA) acting through the NASA Test Support Project Officer.

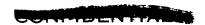
During the prelaunch phase of operations, the Agena B Sub-Working Group of the Joint Atlas-Space Flight Test Working Group will act as the prime mechanism for coordinating flight preparations. Actions of this group which affect the Mariner R project will be subject to final approval of the Project Manager. This working group will consist of representatives of SSD, MSFC, JPL, all associate contractors, major subcontractors, AMC quality control and AMR program management. SSD will chair this group. Among its responsibilities will be:

- 1. Launch vehicle instrumentation assignments and changes.
- 2. Schedule management.
- 3. Review of day-to-day problems.
- 4. Review data and determine subsequent testing.
- 5. Write the launch countdown.
- 6. Launch operation records.

The Pre-AMR operations will be planned and executed by the individual or collective agencies, contractors, and subcontractors directly involved. These operations are monitored by the Project Manager to assure that schedules will be met and that the mission criteria are met.

After arrival of the spacecraft and vehicles at AMR each cognizant agency will proceed individually with tests to assure that nothing was damaged in shipment and to assure a minimum of difficulties during compatibility checks on the launch pad. After these tests are complete JPL and LMSC have the joint responsibility to mate the Agena adapter and shroud to the spacecraft prior to moving from the checkout hangar to the launch pad. JPL will transport the spacecraft/shroud/adapter assembly to the pad. Once the spacecraft arrives at the pad LMSC will mate the spacecraft/shroud/adapter assembly to the Atlas-Agena B. Several tests will then be run. First, JPL will run an On-Pad Functional Test to determine compatibility with facilities. This test does not require the participation of other agencies. All agencies and contractors will then join in a combined RF Interference Test. Following this will be a Joint Flight Acceptance Test (J-FACT), which goes through an accelerated countdown through postlaunch time. Following an acceptable J-FACT test the Range Required Flight Readiness Demonstration shall be run. After completion of these tests LMSC will be responsible for removing the spacecraft/shroud/adapter assembly from the Agena stage and JPL will transport it back to the hangar for flight preparations. Approximately on launch day JPL will transport to the launch pad, where LMSC will again mate the assembly. All agencies will pick up time at approximately X-8 hours.





LMSC has complete responsibility at the launch pad for the installation of cables on the pad and for installing the test racks in the blockhouse. JPL and GD-A will be responsible for the installation of their own peculiar instruments in the racks provided in the blockhouse, and GD-A is responsible for the other on-pad operations and facilities.

The Space Flight Operation Phase will include spacecraft tracking, commanding and data receiving by the Deep Space Instrumentation Facilities (DSIF) located at Goldstone, California, Johannesburg, South Africa, Woomera, Australia, and the Mobile Tracking Station (which will be located near the South African station). It will also include the operations necessary for the communication of tracking, engineering and scientific data and the reduction of this data.

It is the function of the Space Flight Director to support the Project Manager in the preparation and execution of the standard operating procedure for space flight operations. The standard operating procedure is defined to be the method by which the space flight operations will be conducted in both the nominal case and anticipated departures from the nominal case. During Mariner R operations the Space Flight Operations Facility personnel will perform this function.

During the preflight phase, the Space Flight Director is empowered to request information and resolve conflicting requirements, within the framework of existing Laboratory structure and within the authority of the project, as required to fulfill this responsibility.

During the in-flight phase, it is the responsibility of the Space Flight Director to:

- 1. Interpret the standard operating procedure and place requirements consistent with it on the various operating groups.
- 2. Resolve any ambiguities directly associated with the standard operating procedure arising during its execution.
- 3. Make appropriate decisions requiring emergency action to assure success of the mission if the Program Director, Project Manager, or their duly authorized delegates cannot be contacted.

In the fulfillment of this responsibility, the Space Flight Director is accountable to the Project Manager, or duly authorized delegate, and is delegated authority of the Project Manager for placement of requirements on operating groups in accordance with the standard operating procedures.

SECTION IX

PROJECT RESULTS

The project results will be obtained by telemetering and tracking data received from the vehicle during the preinjection period and from the spacecraft during the postinjection period. The George C. Marshall Space Flight Center will be responsible for telemetry and tracking data received during the preinjection phase of flight. These data will be reduced and disseminated to NASA headquarters, JPL, and the vehicle contractors. Reduced tracking data in time to be used for first acquisition by the DSIF will be furnished by MSFC to the JPL Space Flight Director. During the postinjection phase, tracking information will be obtained from the tracking data of the DSIF stations. All telemetry data, both engineering and scientific, will be recorded on magnetic tape at each of the DSIF stations. These tapes will be airmailed to JPL, Pasadena, at the end of each station's tracking day (after 3 days normal procedure is for two stations to operate each day and one station be down for maintenance). -These tapes will be available at JPL within a week from the overseas stations and within a day from Goldstone. Engineering data that are required for making decisions involving the flight operation will be transmitted in near real time to JPL for use of the Space Flight Data Analysis Committee.

The data received over the teletype will indicate successful operation by about 5 hours after launch, if the spacecraft is generally successful in performing such functions as acquisition of the sun and normal operation of the power and communications systems. Successful acquisition of the earth will be known shortly after accomplishment, scheduled for 7 days after launch. In case of failure of some of these functions, the data transmitted over the teletype line may not be adequate to determine what had failed or why, since data transmission capability requirements are based on operational needs and not on postflight analysis requirements. How soon a failure during initial spacecraft operation could be identified would depend on whether the data sent over the teletype was adequate and whether pertinent data was received during the first Goldstone pass. A detailed preliminary description of the initial performance of the spacecraft will be available within 10 days of launch. This will include a statement of what functions have and have not been successfully completed and some preliminary quantitative information on accuracy of the attitude control system, performance of the spacecraft and the accuracy of the design assumptions will be generated throughout the flight.

Scientific information will be distributed to the cognizant experimenters as soon as available. Two months after this dissemination, the Space Science Steering Committee will meet to determine further disposition of the results.

A listing of the postflight reports to be published is included in Section V. Paragraph A5.





MANAGEMENT ASSIGNMENT

ATTACHMENT 1: OVER-ALL

I. PURPOSE

This attachment assigns the responsibilities, authorities and functions for the accomplishment of the Mariner R project in accordance with the Mariner R Project Development Plan.

II. MANAGEMENT ASSIGNMENTS

Management responsibility for the Mariner R project is assigned as follows:

A. Project Management

The Jet Propulsion Laboratory (JPL) is assigned the responsibility of project management for the Mariner R project.

B. Vehicle System Management

The George C. Marshall Space Flight Center (MSFC) is assigned the system management responsibilities for the Atlas-Agena B launch vehicle system, including integration of the space vehicle, and its launch-to-injection system, including securing and coordinating the facilities provided by AMR, contractors, and Department of Defense agencies to supply all necessary ground support and instrumentation items for the prelaunch, launch, and launch-to-injection operational phase.

C. Spacecraft System Management

The Jet Propulsion Laboratory is assigned the spacecraft system management responsibilities including post-injection space flight operations complex.





MANAGEMENT ASSIGNMENT

ATTACHMENT 2: FOR THE PROJECT

JET PROPULSION LABORATORY

I. GENERAL RESPONSIBILITIES

The Jet Propulsion Laboratory is responsible for the accomplishment of the Mariner R project. In accordance with the approved Mariner R Project Development Plan, it will serve as the Project Management Center with the following broad responsibilities:

A. For Project Management

- 1. Integrating the several systems of the project, assuring that such over-all systems engineering activities as may be necessary are carried out.
- 2. Ensuring that oversights and omissions in any aspect of the project are detected and corrected in time to minimize cost overruns, schedule delays, and technical failures.
- 3. Identifying project requirements which have not been anticipated in the Project Development Plan, and actively taking such steps as may be necessary to obtain solutions to these needs.
- 4. Giving appropriate consideration to the responsibility and authority of the Director, Marshall Space Flight Center, for the procurement, modification and integration of the launch vehicle, for the launch of the Mariner R space vehicle, and for the launch-to-injection tracking and instrumentation.

B. For Systems Management

Undertaking and completing the technical design, development, fabrication, testing, and operation of the Mariner R spacecraft system and the post-injection space flight operations complex.

II. SPECIFIC FUNCTIONS AND AUTHORITIES AS SYSTEMS MANAGER

The Director, JPL, within his delegated authority to conduct the activities of his center, will undertake such technical, procurement, budgetary, and other actions as are necessary to develop and operate the spacecraft, and post-injection space flight operations complex.

III. SPECIFIC FUNCTIONS AND AUTHORITY AS PROJECT MANAGER

The Director, JPL, within his delegated authority to conduct the activities of his center, will designate a Project Manager to carry out the following functions for the over-all management of the Mariner R project.

A. Project-wide Planning and Evaluation

1. Initiating and submitting for Headquarters approval Project Development Plan changes which are necessary to revise the technical parameters, the system assignment to the several field centers, or the scheduled dates of accomplishment for the project.





- 2. Maintaining continuous surveillance of schedule milestones for all systems in terms of programmed costs, technical reliability, and completion dates.
- 3. Maintaining a current awareness of all activities within or outside NASA which may affect project accomplishment.
- 4. Devising technical or procedural changes in areas within his own authority, or recommending such changes to higher authority.

The Marshall Space Flight Center, as the Vehicle and Launch-to-Injection Facilities System Manager for the Mariner R, will grant access and information to the JPL Mariner R Project Manager to ensure effective performance of the foregoing function.

B. Systems Integration, Project-wide Systems Engineering, and Scheduling

- 1. Maintaining surveillance over the quality of systems engineering for any of the project's systems to ensure a maximum probability that the several systems will effectively perform their part of the project assignment.
- 2. Deciding interface questions concerning any questions of the interrelationships of the several systems comprising the project.
- 3. Assigning tasks to MSFC with respect to the successful incorporation of the launch vehicle system and launch-to-injection facilities system into the project.
- 4. Assigning tasks to divisions of JPL with respect to the successful integration of its systems into the project.
- 5. Modifying the schedule of spacecraft and post-injection space flight operations complex activities without affecting major milestones in the Project Development Plan.
- 6. Recommending to MSFC changes in the schedules for launch vehicle system milestones in order to ensure scheduling capability among all systems.
- 7. Preparing for Headquarters approval proposed changes in scientific or technical scope or scheduling which go beyond the currently approved Project Development Plan. Such changes will be submitted via the Director of JPL.

The Marshall Space Flight Center, as a System Manager, will consider interface decisions by the Project Manager as conclusive unless promptly appealed to higher authority. MSFC may refer to higher authority for decision on requests of the Project Manager to undertake systems engineering and integration assignments when compliance with such assignments will result in exceeding MSFC's commitment of resources to the project, as set forth in the Project Development Plan.



C. Technical Consultation and Advice

- 1. Establishing such ad hoc advisory bodies as may be appropriate.
- 2. Requesting from appropriate parts of NASA such special technical information as may be required.
- 3. Participating in meetings of technical panels and in launch vehicle procurement management reviews as appropriate.
 - 4. Serving as a member of the NASA Agena B Coordination Board.

MSFC will provide such participation and information as is necessary to the effective execution of the foregoing functions.

D. Budget Requirements and Financial Operating Plans

- 1. Submitting initial budget recommendations for the project or any of its systems to the Director, OSFP, as part of the annual NASA budget preparation, and such revisions on a case-by-case basis as may be requested.
- 2. Obtaining information from the Marshall Space Flight Center with respect to its budgetary requirements for Atlas-Agena B launch vehicles and manpower or funding needed in over-all systems engineering or integration.
- 3. Development and recommending financial operating plans for the systems assigned to JPL, and ensuring that MSFC's proposed financial operating plans for the launch vehicle system are in phase with the over-all project schedule.

MSFC will furnish the Project Manager complete information concerning its budgets and financial operating plans for the launch vehicle and launch-to-injection facilities systems.

E. Financial Management

- 1. Making decisions within the approved financial operating plans or other limitations by Headquarters or the Field Center Director, to commit and/or reprogram funds within JPL as necessary for the prosecution of project assignments.
- 2. Arranging with the approval of the Director, JPL, and Office of Space Sciences, NASA, for the financing of special unbudgeted requirements and studies concerned with over-all systems integration, systems engineering, or reliability.



F. Contracting Activities

- 1. Ensuring that JPL and other NASA elements maintain appropriate technical monitoring over the quality, timing and progress of work placed with outside contractors or other Government agencies.
- 2. Providing close liaison with, and assistance to, procurement officials in their negotiation and administration of contract for the project.
- 3. Requesting such status reports as appear appropriate from MSFC for all launch vehicle system contracts and launch-to-injection system preparations.

MSFC will furnish such specific information as is requested by the Project Manager with respect to its launch vehicle system contracting activities.

G. Reports

- 1. Developing and initiating project reports to keep the Project Manager, the System Managers, and higher authorities informed of project progress.
- 2. Furnishing project reports to the Headquarters and the field centers, as established in the Project Development Plan. (In particular ensuring that MSFC is fully and currently informed of Mariner R spacecraft, and post-injection space flight operations complex.)
- 3. Ensuring that data resulting from the project are disseminated in accordance with the provisions of the Project Development Plan.

MSFC will meet the reporting requirements established within MSFC by the Mariner R Project Development Plan and those determined by the Mariner R Project Manager.

IV. INTERNAL ORGANIZATIONAL ASSIGNMENTS

The Director of the Jet Propulsion Laboratory will retain over-all responsibility for the performance of project and systems assignments entrusted to his center. He shall assign the immediate responsibility for the foregoing functions and responsibilities to an appropriate project management and system management staff as established within JPL and described in the Mariner R Project Development Plan.

V. AUTHORITY LIMITATIONS

Authority delegated herein shall be exercised in accordance with applicable laws and regulations.

CONFIDENTIAL

MANAGEMENT ASSIGNMENT

ATTACHMENT 3: FOR LAUNCH VEHICLE SYSTEM

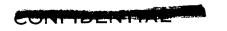
MARSHALL SPACE FLIGHT CENTER

I. GENERAL RESPONSIBILITIES

- A. The Marshall Space Flight Center (MSFC) is responsible for successful procurement, modification, and operation of the NASA Atlas-Agena B Launch Vehicle System and the Mariner R Launchto-Injection Facilities System. In accordance with the approved Mariner R Project Development Plan it will serve as the Launch Vehicle and Launch-to-Injection Facilities System Management Center with the following broad responsibilities:
- 1. Undertaking and completing the technical design, development, fabrication, testing, and operation of the NASA Atlas-Agena B vehicle, through contracts to vehicle system suppliers via the Air Force Space Systems Division.
- 2. Coordinating vehicle system procurement and modification with the requirements of other systems and the project as a whole, as established in the Mariner R Project Development Plan and as determined by the Project Manager.
- 3. Ensuring that requested launch vehicle modifications do not compromise the launch vehicle's minimum requirements for reliable performance.
- 4. Undertaking the launch and launch-to-injection operation of the Mariner R space vehicle and the launch-to-injection facilities system.
 - B. In carrying out the foregoing responsibilities the Marshall Space Flight Center will:
- 1. Ensure that oversights and omissions within the systems are detected and corrected in time to minimize cost overruns, schedule delays, and technical failures; and
- 2. Identify system requirements which go beyond the provisions of the Mariner R Project Development Plan and, in consultation with the Project Manager, initiate or seek solutions to these needs.

II. SPECIFIC FUNCTIONS AND AUTHORITIES

The Director, MSFC, in accordance with his delegated authority to conduct the activities of his center and with recognition of his obligations to support the Jet Propulsion Laboratory with respect to its over-all management of the Mariner R project, will undertake all technical, procurement, budgetary and other actions which are necessary to successful development and operation of the launch vehicle system and launch-to-injection facilities system established in the Mariner R Project Development Plan. The Director, MSFC, shall designate a Mariner R Vehicle System Manager to undertake the following functions:





A. System Engineering and Scheduling

- 1. Directing all system engineering on the launch vehicle including integration of the space vehicle necessary to meet Mariner R project requirements.
 - 2. Deciding interface questions among subsystems within the launch vehicle.
- 3. Requesting other parts of NASA to undertake work with respect to contract monitoring, testing, reliability studies, or other activities as appropriate to achieve the technical compatibility of subsystems.
- 4. Determining and recommending for Project Manager, Center Director, and Headquarters approval and schedule (and changes in the schedule) affecting the launch vehicle system and launch-to-injection ground system.

B. Participation in Overall Systems Integration

- 1. MSFC will consider interface decisions and task assignments made by the Project Manager or the Director of JPL, concerning over-all systems integration to be conclusive until (or unless) reversed by higher authority.
- 2. Task assignments from the Project Manager may be referred for decision by higher authority when acceptance would overtax MSFC resources beyond the agreed commitments as specified in the Project Development Plan.
- 3. MSFC will participate fully in reporting, information, advisory, and other procedures designed to provide the Project Manager with optimum cognizance of all project systems. These procedures may be either those established in the Project Development Plan, or special requests and procedures made by the Project Manager pursuant to project management authority.

C. Technical Consultation and Advice

- 1. Establishing such ad hoc advisory bodies as the launch vehicle system and launch-to-injection facilities system require.
- 2. Requesting from appropriate parts of NASA such special technical information as may be required by the launch vehicle and launch-to-injection facilities system.
- 3. Participating in meetings of technical panels and in launch vehicle procurement management reviews.
 - 4. Serving as a member of the NASA Agena B Coordination Board.

D. Budget Requirements and Financial Operating Plans

1. Submitting to the Project Manager initial budget recommendations for Atlas-Agena B launch vehicle procurement and launch-to-injection facilities system preparation as part of the total project estimates for the annual NASA budget preparation and such revisions as a case-by-case basis as may be requested.



- 2. Developing and recommending to the Director, MSFC, financial operating plans for the launch vehicle system and launch-to-injection facilities system (or changes in such plans) which are in phase with the over-all Mariner R project schedules.
- 3. Furnishing to the Project Manager such financial information on the launch vehicle system and launch-to-injection facilities system as the Project Manager may request.

E. Financial Management

Making decisions, within approved financial operating plans or other limitations by Head-quarters or the Marshall Space Flight Center Director, to commit funds and/or to reprogram funds as necessary within allocations for the Atlas-Agéna B vehicles and the launch-to-injection facilities system.

F. Contracting Activities

- 1. Ensuring appropriate technical monitoring over the quality, timing, and costs of launch vehicle work placed with contractors or other Government agencies.
- 2. Providing close liaison with, and assistance to, MSFC procurement officials in their negotiation and administration of launch vehicle system contracts.
- 3. Ensuring that activities of Air Force and Atlantic Missile Range contractors are technically and contractually sufficient to produce the required launch-to-injection facilities system on schedule.

G. Reports

Furnishing launch vehicle system and launch-to-injection facilities system reports to Head-quarters, the Project Manager, and other parts of NASA, as indicated in the Mariner R Project Development Plan, or furnishing such additional information as may be requested by the Project Manager.

III. INTERNAL ORGANIZATIONAL ASSIGNMENTS

The Director, MSFC, will retain over-all responsibility for the performance of systems assignments entrusted to his center. He shall assign such of the foregoing functions and responsibilities to an appropriate system management staff as established within the MSFC by the Mariner R Project Development Plan.

IV. AUTHORITY LIMITATIONS

Authority delegated herein shall be exercised in accordance with applicable laws and regulations.



ATTACHMENT 4

VEHICLE SYSTEM SUPPORT TO BE PROVIDED BY

MSFC ORGANIZATIONS

1. AEROBALLISTICS DIVISION

- a. Performs independent reviews and analysis for the Vehicle System Managers in the areas of configuration optimization trajectory design, and flight performance.
- b. As specialist in the field of trajectory calculation, verify contractors capability and support Vehicle System Managers in correcting questionable data.
- c. As required by Vehicle System Managers, review and recommend modification and additions to instrumentation for better flight evaluation.
- d. Perform independent studies for the Vehicle System Manager in the fields of dynamics, control, propellant sloshing, etc.
- e. Recommend and support the Vehicle System Managers in the areas such as windtunnel testing, stability problems, etc.
- f. Solve problems within areas of specialization as may be discovered and/or suspected during the course of the program.
- g. Supply specialists for panels and/or committees established within the program with responsibilities concerning areas of interest to Aeroballistics Division.

2. COMPUTATION DIVISION

- a. Perform data reduction and analysis of both contractor and "in-house" support functions.
- b. Evaluates and/or formulates programs for data processing.
- c. Serves as specialist to Vehicle System Manager in setting up program reporting systems.
- d. Supply specialists for panels and/or committees established within the program with responsibilities concerning areas of interest to Computation Division.

3. FABRICATION AND ASSEMBLY ENGINEERING DIVISION

- a. Supplies a group of technical personnel highly specialized in manufacturing and assembling launch vehicles.
- b. Review facility requirements and schedules, and budgets in connection with Vehicle System Manager and recommend realinement where improvements in program are required.
 - c. Recommends processes and special equipment compatible with the program.





- d. Develops standard of performance for contractors.
- e. Solve problems within areas of specialization as may be discovered and/or suspected during the course of the program.
- f. Supply specialists, for panels and/or committees established within the program with responsibilities concerning areas of interest, to Fabrication and Assembly Engineering Division.

4. GUIDANCE AND CONTROL DIVISION

- a. Analyze and determine guidance system error sources and magnitudes.
- b. Performs independent reviews and analysis for the Vehicle System Manager in the areas of (a) vehicle stabilization and control, (b) adequacy of proposed guidance and control systems for prescribed or deep space missions, and (c) further development and/or refinements of current guidance and control systems.
 - c. Assists in the determination and establishment of proper qualification tests for G&C systems.
- d. Solve problems within areas of specialization as may be discovered and/or suspected during the course of the program.
- e. Supply specialists for panels and/or committees established within the program with responsibilities concerning areas of interest to Guidance and Control Division.

5. QUALITY DIVISION

- a. Evaluates quality assurance programs and the administering organizations. Recommends changes as required to insure delivery of an acceptable item.
 - b. Review, analyze, and recommend in regard to checkout equipment and procedures.
- c. Provide, within the division capabilities, trained and/or guidance as may be required to increase level of competence and effectiveness in government and contractor quality assurance organizations.
- d. Provide monitoring and/or followup service to insure that the contractor is adhering to established policies and procedures.
- e. Solve problems within areas of specialization as may be discovered and/or suspected during the course of the program.
- f. Supply specialists for panels and/or committees established within the program with responsibilities concerning areas of interest to Quality Division.

6. STRUCTURES AND MECHANICS DIVISION

a. Review and advise Vehicle System Manager Offices as to adequacy and/or correctness of contractor's calculation pertaining to heat transfer and thermal characteristics and shroud.





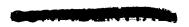
- b. Performs dynamic analysis of separation devices the possibility and/or probability of shroud vehicle collision, etc.
- c. Make independent studies and advise contractor in solving problems of liquid hydrogen venting, zero "G" conditions, and safety.
- d. Perform, review and/or advise Vehicle System Manager Offices relative to vehicle structure analysis.
 - e. Analyze propulsion systems in detail and recommend solutions to problems as they arise.
- f. Solve problems within areas of specialization as may be discovered and/or suspected during the course of the program.
- g. Supply specialists for panels and/or committees established within the program with responsibilities concerning areas of interest to Structures and Mechanics Division.

7. TEST DIVISION

- a. Review and recommend in the formulation of environmental and static test programs.
- b. Evaluate and recommend changes in existing procedures.
- c. Review and evaluate test data and make recommendations as appropriate.
- d. Review and recommend facility and test instrumentation requirements.
- e. Recommend extensiveness of test programs.
- f. Solve problems within areas of specialization as may be discovered and/or suspected during the course of the program.
- g. Supply specialists for panels and/or committees established within the program with responsibilities concerning areas of interest to Test Division.

8. TECHNICAL PROGRAM COORDINATION OFFICE

- a. Assists in the formulation of Program Budget requirements.
- b. Reviews programs and schedule performance in light of total project.
- c. Assists in setting up reporting procedure.
- d. Recommends and formulates solutions to management problems particularly when they pertain to overall center policies.
 - e. Participates in evaluating proposal.
- f. Supply specialists for panels and/or committees established within the program with responsibilities concerning areas of interest to Technical Program Coordination Office.



9. RELIABILITY OFFICE

- a. Establishes policy for all reliability programs within MSFC.
- b. Evaluates and monitors all reliability programs.
- c. Supply specialists for panels and/or committees established within the program with responsibilities concerning areas of interest to Reliability Office.

10. LAUNCH OPERATIONS DIRECTORATE

The Director, Launch Operations Directorate, should designate an individual or individuals who will be constantly concerned with and responsive to the needs of the programs being administered by the M-AC in the area of endeavor requiring the specialized abilities of that directorate. General types of support activities anticipated include:

- a. AMR-LOD serves as the Launch Director with over-all launch responsibilities including monitoring of checkout, scheduling, countdown, and tracking operations. Has complete systems integration responsibility including supervising the contractors, maintenance of launch facilities, participation in countdown as test controller, and launch site management.
- b. Furnish appropriate representation on any panels and/or committees established which are concerned with operations and/or facilities.

ATTACHMENT 5

JPL/MSFC MEMORANDUM OF AGREEMENT FOR INTERFACE DESIGN

OF MARINER AND SURVEYOR

PERFORMANCE, GUIDANCE, AND TRAJECTORIES

1. PURPOSE

The purpose of this memorandum is to delineate the roles and responsibilities of JPL and MSFC in the interface areas associated with performance, guidance and trajectories, and to establish mutual agreements, procedures and policies whereby the design tasks in these areas may be executed.

2. REMARKS

- a. Since it is neither possible nor desirable to establish all of the explicit procedures that will be required, this document establishes only the general intent. In the relatively new field of interplanetary missions, the procedures learned in ballistic missile and earth satellite programs may require modification; hence flexibility is essential. The design of the mission will require much exchange of information between JPL and MSFC, a careful understanding by each of the other's problems, and continued iterations to achieve the final design parameters.
- b. In the discussion which follows two areas will be recognized: design, in which the parameters describing the performance, guidance and trajectories are obtained, and simulation, in which the choice of these parameters is evaluated and proved.

3. GENERAL

The design of the post-injection guidance system and post-injection trajectories will be accomplished by JPL. The design of the pre-injection guidance system and pre-injection trajectory will be accomplished by MSFC either in house or by contractors.

4. ROLE OF JPL IN DESIGN

a. Responsibility

JPL will design the post-injection guidance system and trajectories to satisfy the mission objectives.

b. Discussion

The design of the post-injection trajectories and guidance system is an engineering task which requires continuous effort terminating at the end of the mission. This effort encompasses the selection of post-injection trajectories which satisfy the spacecraft design constraints, the generation of trajectory data necessary for spacecraft design, and the generation of trajectory data necessary to accomplish such flight operations as orbit determination, midcourse guidance and scientific measurements. This is an integrated effort intimately associated with the spacecraft design and engineering. As such it requires day-to-day re-evaluation and minor modification of the post-injection trajectories by JPL.





c. Execution of Interface Tasks

JPL will provide criteria to be met by the launch vehicle at the injection point in the areas of:

- 1. Separated spacecraft weight
- 2. Trajectory
- 3. Accuracy

Under 1, the weight of the separated spacecraft at the injection point will be given.

Under 2, the trajectory will be defined in terms of the required injection energy and direction angles of the outgoing asymptote of the escape hyperbola as a function of launch time. In particular, JPL will issue a design specification stating the mathematical formulation of the criteria as well as the numerical values of the energy and asymptote. Under 3, accuracy, JPL will supply to MSFC a rigorous method of transforming errors at injection to a spacecraft FOM (Figure of Merit). An upper boundary on the FOM will be specified by JPL, and it will be requested that, where considered desirable by MSFC, the injection vehicle minimize the FOM (it is currently planned that the FOM be a measure of the total propellant consumption required for post-injection trajectory corrections).

Finally, JPL will provide to MSFC descriptions of:

- 1. The over-all spacecraft missions
- 2. The operation of the post-injection trajectory correction system
- 3. The methods whereby post-injection trajectories are computed.

5. ROLE OF MSFC IN DESIGN

a. Responsibilities

The design of the pre-injection trajectories and the injection guidance system to satisfy the mission objectives and other restraints will be accomplished by MSFC either in-house and/or by contractors.

b. Discussion

The design of the pre-injection trajectories and guidance systems is an engineering task which requires continuous effort throughout the mission. This effort encompasses the selection of pre-injection trajectories which satisfy the launch vehicle design constraints, the generation of trajectory data necessary for boost vehicle design, and the generation of trajectory data to accomplish flight operations such as tracking, injection guidance and range safety.

It is further agreed that this is an integrated effort, intimately associated with the launch vehicle design and engineering, and as such requires day-to-day re-evaluation and modification of the pre-injection trajectories.



c. Execution of Interface Tasks

In accordance with the procedures established above, MSFC will carry out design tasks in the areas of pre-injection:

- 1. Performance
- 2. Trajectories
- 3. Guidance

Under 1, MSFC will provide JPL with the performance capability of the injection vehicle in the form of allowable separated spacecraft weight as a function of injection energy and other pertinent parameters.

Under 2, MSFC will provide JPL with the injection conditions for the post-injection trajectory in the form of injection time, position vector, and velocity vector. These injection conditions will satisfy the specified energy and asymptote.

Under 3, MSFC will provide JPL with the description of the accuracy of the injection guidance system in the form of a statistical description of the errors at the injection point and evaluate the FOM.

In addition, MSFC will provide JPL with a description of the injection vehicle.

6. PREFLIGHT SIMULATION

In order to ensure that the injection interface has not permitted errors to remain undetected, and further to assure that the system functions properly in the presence of disturbances, a preflight simulation which involves the running of launch-to-"target" trajectories is essential. It is noted under Section II that it is not profitable to attempt to establish the details of such simulation at this time; however, it is intended that there be such simulation. For the purposes of simulation JPL will provide a trajectory program for the post-injection phase to be mated to a trajectory program of the pre-injection phase provided by MSFC. Using this combined program MSFC and JPL will cooperatively generate the preflight standard trajectories and perform the preflight simulation to assure satisfaction of the over-all mission objectives.



ATTACHMENT 6

PROCEDURE FOR PROCESSING BOOSTER REQUIREMENTS DOCUMENTS (BRD) AND PROGRAM REQUIREMENTS DOCUMENTS (PRD) FOR NASA/JPL SPACECRAFT PROGRAMS

1. Booster Requirements Documents (BRD)

- a. For new BRD's the steps shall be as follows:
 - (1) All agencies involved will submit to LMSC inputs for preparation of a preliminary BRD.
 - (2) LMSC, using the above information, will prepare and issue review copies of the preliminary BRD to appropriate NASA activities and AFSSD for comments.
 - (3) Written comments will be forwarded to NASA Test Support Office (NTSO) for coordination. Any coordination and review meetings required will be called by NTSO.
 - (4) Coordinated changes will be forwarded to LMSC through SSVR with copy to M-L&M-A.
 - (5) LMSC will incorporate changes into final BRD. NTSO will maintain direct liaison with LMSC during this phase so that cognizance of progress may be maintained.
 - (6) LMSC will furnish copies of the final BRD to SSVR to fulfill contractual obligations and will simultaneously furnish copies to NTSO for obtaining signatures and releasing to AMR for publication.
- b. Revisions of a corrective nature shall be processed as follows:
 - (1) Proposed revisions and changes will be submitted to NTSO with copy to M-L&M-A.
 - (2) NTSO will coordinate the changes and, dependent on the volume of the changes, either make the necessary revisions or submit the information through SSVR with copy to M-L&M-A to LMSC for incorporation.
 - (3) In those cases where LMSC is called upon for revisions, revised sheets will be submitted to SSVR and NTSO simultaneously.

2. Program Requirements Documents (PRD)

- a. For new PRD's and revisions to incorporate additional missions the steps shall be as follows:
 - (1) All agencies involved will submit to JPL inputs for preparation of a preliminary PRD or for a PRD revision.





- (2) JPL, using the above information, will prepare and issue review copies of the preliminary PRD or the revision to appropriate NASA activities for comment.
- (3) Written comments will be forwarded to NASA Test Support Office (NTSO) for coordination. Any coordination and review meetings required will be called by NTSO.
 - (4) Coordinated changes will be forwarded to JPL with copy to M-L&M-A.
- (5) JPL will incorporate changes into final PRD. NTSO will maintain direct liaison with JPL during this phase so that cognizance of progress may be maintained.
- (6) JPL will furnish copies of the final PRD to NTSO for obtaining signatures and releasing to AMR for publication.
 - b. Revisions of a corrective nature (other than additional missions) shall be processed as follows:
 - (1) Proposed revisions and changes will be submitted to NTSO with copy to M-L&M-A.
- (2) NTSO will coordinate the changes and, dependent on the volume of the changes, either make the necessary revisions or submit the information, with copy to M-L&M-A, to JPL for incorporation.